TELECTRO INDUSTRIES
SG-1A/ARN in SG-1 Book

T.O. 33A1-8-47-32

TO 33A1-8-47-24
Book 103

HANDBOOK
SERVICE INSTRUCTIONS

SIGNAL GENERATOR SG-1A/ARN

(TELECTRO INDUSTRIES CORP.)

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE
AND THE CHIEF OF THE BUREAU OF AERONAUTICS

AF-WP-REPRINT-O-17 FEB 58 800

15 NOVEMBER 1955

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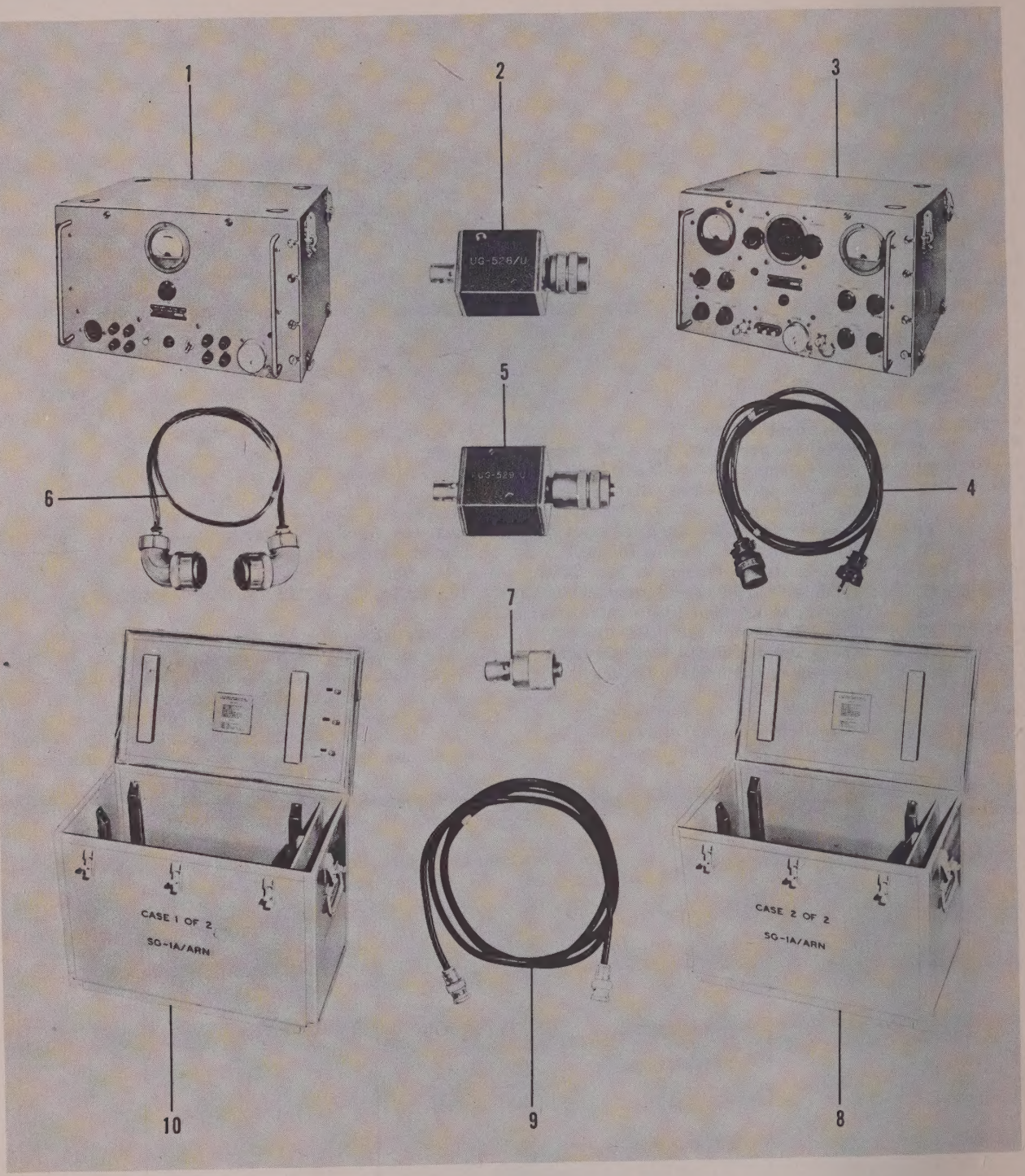


1. Power Supply PP-348/ARN
2. Connector Adapter UG-528/U
3. Signal Generator SG-1A/ARN
4. Cord CX-237/U
5. Connector Adapter UG-529/U
6. Cable Assembly CX-1290/ARN
7. Connector Adapter UG-201/U
8. Transit Case CY-1069/U
9. Cable Assembly CG-409/U
10. Transit Case CY-1068/U

Figure 1-1. Signal Generator SG-1A/ARN, Major Components

SECTION I

DESCRIPTION AND LEADING PARTICULARS

1-1. PURPOSE OF HANDBOOK.

1-2. This publication comprises service instructions for Signal Generator SG-1A/ARN and Power Supply PP-348/ARN (figure 1-1), manufactured by Telectro Industries Corp., Long Island City, New York.

1-3. PURPOSE OF THE EQUIPMENT.

1-4. Signal Generator SG-1A/ARN is used for testing and aligning Radio Receiving Set AN/ARN-14, Radio Receiving Equipment RC-103 and other equipment which operates within the range of the test equipment. Power Supply PP-348/ARN delivers both a-c and d-c voltages for operation of the signal generator.

1-5. PHYSICAL DESCRIPTION.

1-6. Signal Generator SG-1A/ARN (see figure 1-2) is supplied in gray-finish metal hinged Transit Case CY-1068/U. The signal generator can be removed after opening the latches securing the hinged lid of the transit case. The signal generator is housed in a gray-finish metal cabinet, and the front panel contains two meters, frequency dial, selector knobs, dial lock, three cable connectors, an indicator lamp, three terminals and eight switch and control knobs. The signal generator measures 19-1/2 in. wide x 11 in. high x 14-1/4 in. deep and weighs 36-1/2 lbs. Transit Case CY-1068/U measures 24 in. wide x 18-1/4 in. high x 16-1/4 in. deep, and weighs 34 lbs.

1-7. Power Supply PP-348/ARN (see figure 1-3) is supplied in gray-finish metal hinged Transit Case CY-1069/U. The power supply can be removed after opening the latches securing the hinged lid of the transit case. The power supply is housed in a gray-finish metal cabinet, and the front panel contains a voltmeter, two switches, four fuses, and four spare fuses, two connectors and an indicator lamp. The power supply measures 19-1/2 in. wide x 11 in. high x 14-1/4 in. deep, and weighs 60 lbs. Transit Case CY-1069/U measures 24 in. wide x 18-1/4 in. high x 16-1/4 in. deep, and weighs 34 lbs.

1-8. EQUIPMENT SUPPLIED.

1-9. Table I lists the major components supplied with the equipment. Refer to figure 1-1 for identification of the components.

1-10. BASIC PRINCIPLES OF OPERATION.

1-11. The equipment develops modulated and unmodulated r-f signals, in the range of 88 mc to 140 mc, that simulate signals transmitted by v-h-f omnidirectional range systems, tone or phase localizer systems, v-h-f two-course range systems, and amplitude modulated tone intelligence. The signal generator may be used to test v-h-f communications receivers within the range of 88 mc and 140 mc. For testing navigation circuits, Modulator MD-83A/ARN, or equivalent, is required.

TABLE I. EQUIPMENT SUPPLIED

Fig. 1-1 Ref.	Quantity per Equipment	Component	Type Designation	Dimensions (inches)	Weight (lbs.)
-3	1	Signal Generator	SG-1A/ARN	19-1/2x11x14-1/4	36.5
-1	1	Power Supply	PP-348/ARN	19-1/2x11x14-1/4	60
-10	1	Transit Case	CY-1068/U	24x18-1/4x16-1/4	34
-8	1	Transit Case	CY-1069/U	24x18-1/4x16-1/4	34
-5	1	Adapter	UG-529/U	1-1/8x1-1/4x3-3/8	.25
-2	1	Adapter	UG-528/U	1-1/8x1-1/4x1-1/8	.25
-7	1	Adapter	UG-201/U	1-1/2x3/4	.1
-9	1	Cable Assembly	CG-409/U	60	.5
-6	1	Cable Assembly	CX-1290/ARN	72	2
-4	1	Cord	CX-237/U	120	1

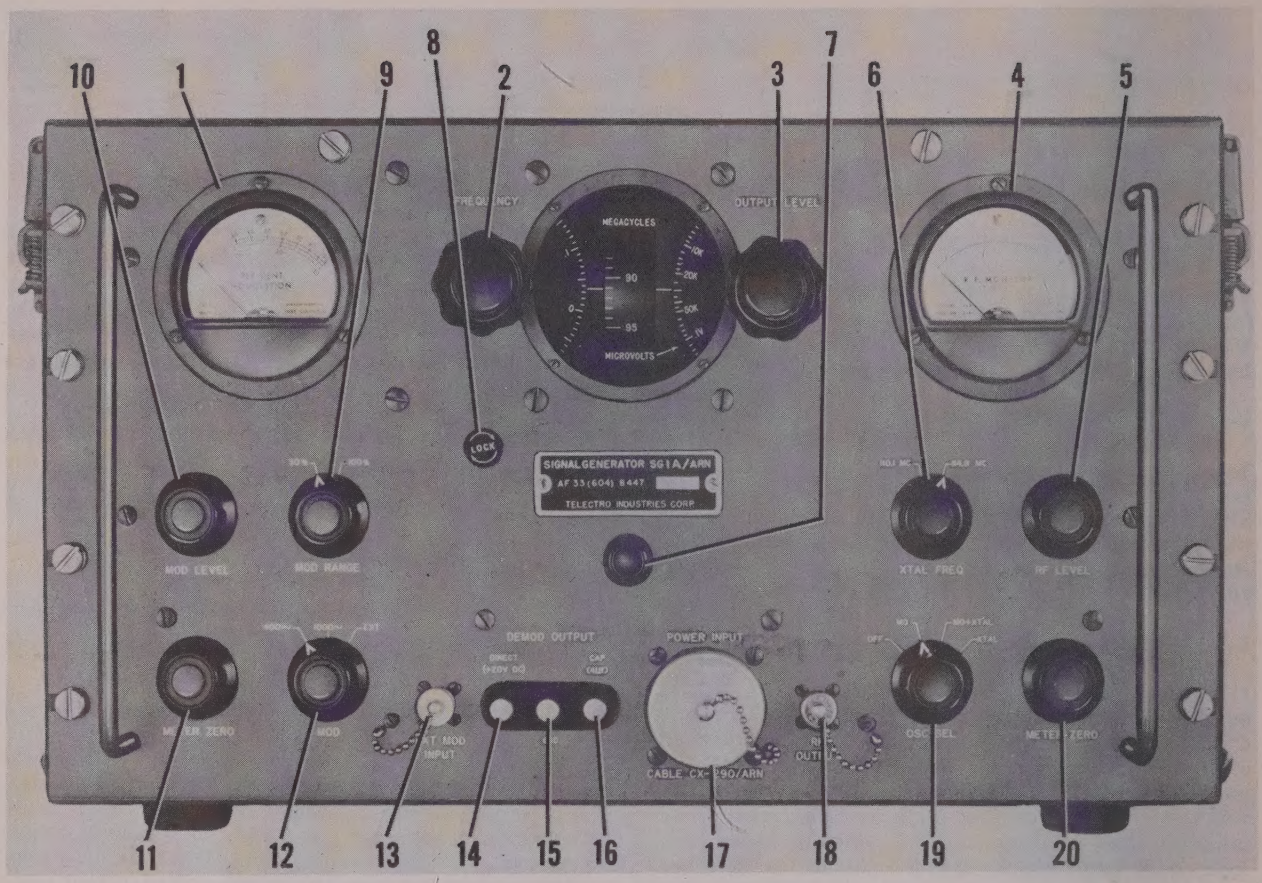


Figure 1-2. Signal Generator SG-1A/ARN, Front Panel

1-12. SIGNAL GENERATOR SG-1A/ARN. (See figure 1-2.)

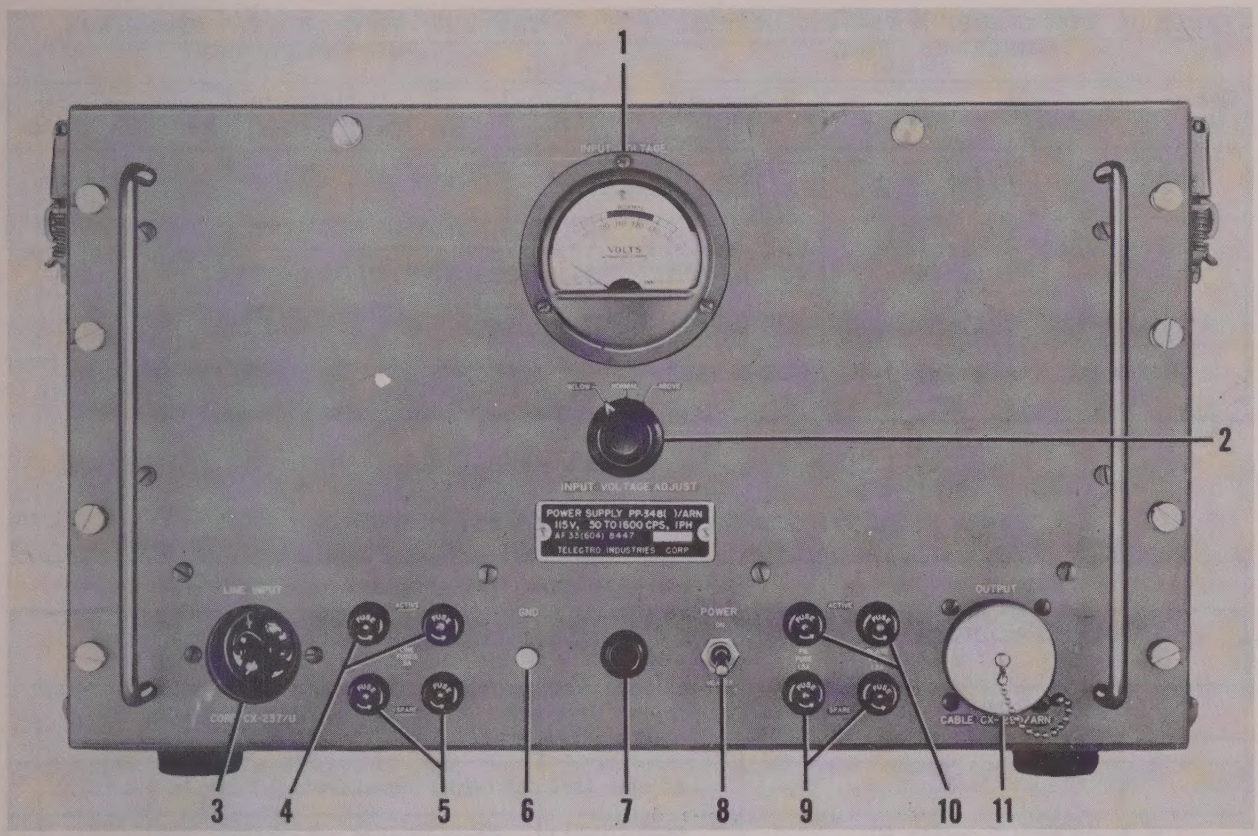
1-13. The signal generator covers the range between 88 mc and 140 mc, and provides two crystal-controlled calibration frequencies at 110.1 mc and 114.9 mc. Beat frequencies developed by the output frequencies and harmonics of the crystal oscillator beating against the master oscillator are available for calibrating the variable frequency oscillator. In addition, the signal generator develops audio signals of 400 cps and 1000 cps which are used to modulate the r-f output of the generator.

1-14. External modulation can be applied to the generator through a connector on the front panel. The output can be modulated up to 100 per cent and the percentage of modulation is indicated on the PER CENT MODULATION meter (1). The meter has two ranges, 30 per cent and 100 per cent.

1-15. R-f output taken from R-F OUTPUT connector (18) is adjustable from 0.1 microvolt to 0.2 volt by the setting of OUTPUT LEVEL knob (3) on the front panel. A single-ended piston type attenuator, terminated by a 53-ohm load impedance, is employed in the output circuit. Demodulated output is available at terminals on the front panel marked DEMOD OUTPUT. One terminal (14) marked DIRECT (+20VDC) is connected directly to the signal output to provide a signal with low phase shift. The other output terminal (16), marked CAP (4uf), is connected through a capacitor and is used with units having low input impedances or with units not containing an external blocking capacitor. The center terminal (15) is common and is marked GND.

1-16. POWER SUPPLY PP-348/ARN. (See figure 1-3.)

1-17. The power supply delivers all filament, plate and screen voltages required by the signal generator. The power supply requires a power source of 105 to 125 volts, ac, 50 to 1600 cps, and consumes approximately 180 watts. The power supply delivers regulated high voltages of 575 volts dc at 10 to 90 ma, 200 volts dc at 10 to 90 ma, and 7.2 volts ac at 2.7 amperes. Filament voltage is regulated by a ballast tube in series with one side of the heater line. A time delay relay is used to protect the tubes of the signal generator against damage from high voltage surges during the warm-up period. A heater connected to the input power is energized when the power cable is connected to an a-c source and the POWER-ON-HEATER switch (8) is in the HEATER position. The heater maintains the equipment at a temperature suitable to safeguard



1. INPUT VOLTAGE meter
2. INPUT VOLTAGE ADJUST
3. LINE INPUT
4. ACTIVE LINE FUSES 3A
5. SPARE fuses
6. GND
7. Indicator Lamp
8. POWER-ON HEATER
9. SPARE fuses
10. ACTIVE fuses
11. OUTPUT

Figure 1-3. Power Supply PP-348/ARN, Front Panel

the equipment against the effects of humidity. A heater in the signal generator is used for the same purpose, and is operative when the units are connected together.

1-18. TUBE AND FUSE COMPLEMENT.

1-19. Tables II, III, and IV list the tubes and fuses used in both units.

TABLE II. SIGNAL GENERATOR SG-1A/ARN, TUBE COMPLEMENT

Quantity	Type No.	Function	Reference Symbol
1	JAN 6AK5W	Variable oscillator	V1001
1	JAN 6AK5W	Doubler	V1002
1	JAN 6AK5W	Doubler-output	V1003
1	JAN 12AX7	Demodulator-cathode follower	V1004A, B
1	JAN 6AK5W	Crystal oscillator	V1005

TABLE II. SIGNAL GENERATOR SG-1A/ARN, TUBE COMPLEMENT (cont)

Quantity	Type No.	Function	Reference Symbol
1	JAN 6AK5W	Quadrupler	V1006
1	JAN 2C51	Audio oscillator	V901A, B
1	JAN 12AX7	Vtvm-cathode follower meter output	V902A, B
1	JAN 2C51	Amplifier-meter balance	V903A, B
1	JAN 6V6GT	Modulator	V904

TABLE III. POWER SUPPLY PP-348/ARN, TUBE COMPLEMENT

Quantity	Type No.	Function	Reference Symbol
1	JAN 5R4WGY	High voltage rectifier	V801

TABLE III. POWER SUPPLY PP-348/ARN, TUBE COMPLEMENT (cont)

Quantity	Type No.	Function	Reference Symbol
1	JAN 5Y3	Low voltage rectifier	V802
4	JAN 6B4G	Series regulators	V803, V804, V807 & V808
2	JAN 6AU6	Control tube	V805 & V809
2	JAN OA3/ VR75	Voltage regulator	V806 & V810

TABLE IV. POWER SUPPLY PP-348/ARN, FUSE COMPLEMENT

Quantity	Type No.	Ampere Rating	Reference Symbol
2	Type 3 AG	3.0 amp	F803 and F804
2	Type 3 AG	1.5 amp	F801 and F802

1-20. DESCRIPTION OF CONTROLS.

1-21. SIGNAL GENERATOR SG-1A/ARN.

1-22. Table V lists the various controls on the front panel and describes the function of each. Refer to figure 1-3 for location of controls.

TABLE V. SIGNAL GENERATOR SG-1A/ARN, OPERATING CONTROLS

Control	Function
PER CENT MODULATION meter (1)	Indicates the percentage of modulation of the output signal.
FREQUENCY (2)	Selects frequency of generated signal; consists of main and vernier dials.
OUTPUT LEVEL (3)	Adjusts level of output signal from 0.1 mv to 0.2 v.
R. F. MONITOR meter (4)	Meter used to indicate level of r-f carrier.
RF LEVEL (5)	Potentiometer used to adjust the level of R. F. MONITOR meter.
XTAL FREQ (6)	Switch used to select either 110.1 mc or 114.9 mc crystal-controlled frequency.
Indicator Lamp (7)	Indicates filament voltage connected to tubes in signal generator.
LOCK (8)	Knob used to lock frequency dial.
MOD RANGE (9)	Switch used to select either 30 per cent or 100 per cent modulation of carrier.
MOD LEVEL (10)	Potentiometer used to adjust level of modulation.
METER ZERO (11)	Potentiometer used to zero PER CENT MODULATION meter.
MOD (12)	Switch used to select either 400 cycle, 1000 cycle or external modulation.
EXT MOD INPUT (13)	Binding post used to couple external modulating signal to modulating amplifier.
DEMOD OUTPUT-- DIRECT (+20V) (14)	Connector for direct coupled audio signals from generator.
GND (15)	Binding post for ground connection.
CAP (4uf) (16)	Binding post for capacitor coupled signals from generator.

TABLE V. SIGNAL GENERATOR SG-1A/ARN, OPERATING CONTROLS (cont)

Control	Function
POWER INPUT (17)	Connector for a-c and d-c power connections to signal generator.
RF OUTPUT (18)	Connector used to monitor r-f output of generator.
OSC. SEL (19)	Connects B+ to master oscillator and/or crystal oscillator.
METER ZERO (20)	Potentiometer used to zero R. F. MONITOR meter.

1-23. POWER SUPPLY PP-348/ARN.

1-24. Table VI lists the various controls on the front panel and describes the function of each. Refer to figure 1-3 for location of controls.

TABLE VI. POWER SUPPLY PP-348/ARN, OPERATING CONTROLS

Control	Function
INPUT VOLTAGE meter (1)	Used to indicate input voltage.
INPUT VOLTAGE ADJUST (2)	Switch to select input voltage for power supply.
LINE INPUT (3)	Switch to select input voltage for power supply.
ACTIVE LINE FUSES 3A (4)	Fuses for input voltage.
SPARE fuses (5)	Spare fuses for input voltage.
GND (6)	Ground connector.
Indicator Lamp (7)	Indicates power is connected to V809 and to high voltage time delay relay.
POWER-ON-HEATER (8)	Switch to connect 115v a-c power to transformers or to space heaters.
SPARE fuses (9)	Spare fuses for primary winding of power transformer.
ACTIVE fuses (10)	Fuses for transformer primaries.
OUTPUT (11)	Connector for a-c and d-c voltages to signal generator.

SECTION II

TEST EQUIPMENT AND SPECIAL TOOLS

2-1. No special tools or test equipment are required to service the equipment.

SECTION III

PREPARATION FOR USE AND RESHIPMENT

3-1. UNPACKING.

3-2. No special procedures are required to unpack the equipment. Carefully remove the equipment from the shipping containers and place the equipment near the location where it will be used.

3-3. INSTALLATION.

3-4. Carefully remove Signal Generator SG-1A/ARN and Power Supply PP-348/ARN and all the components from the transit cases. Both major units are self-contained and may be installed individually or stacked, one above the other, and clamped together. If it is desired to rack-mount the units, remove the ten screws on the front panel of each unit, slide the unit out of the cabinet, and install each unit in the rack.

3-5. PRELIMINARY PROCEDURE.

3-6. Before using the equipment the following procedure should be followed:

a. Check all operating controls and switches for ease of rotation, binding, scraping and positive action.

b. Check ACTIVE and SPARE fuses (4, 5, 9 and 10, figure 1-3).

c. Check DEMOD OUTPUT binding posts (14, 15 and 16, figure 1-2).

d. Connect Cable CX-1290/ARN to POWER INPUT (17, figure 1-2) and OUTPUT (11, figure 1-3) connectors.

e. Connect Cord CX-237/U to LINE INPUT (3, figure 1-3) and to 115v ac line.

f. Throw POWER-ON-HEATER switch (8, figure 1-3) to ON. Indicator lamps (7, figure 1-2 and 7, figure 1-3) on both units should be illuminated, and INPUT VOLTAGE meter (1, figure 1-3) should indicate 115. Turn POWER-ON-HEATER switch to HEATER.

g. Connect Cable Assembly CG-409/U to RF OUTPUT connector (18, figure 1-2).

3-7. ADJUSTMENT AND OPERATION.

3-8. POWER SUPPLY PP-348/ARN.

3-9. Make sure all connections have been made as indicated in paragraph 3-6 and proceed as follows:

a. Throw POWER-ON-HEATER switch (8, figure 1-3) to HEATER. Allow five minutes for warm-up.

b. Throw POWER-ON-HEATER switch to ON. Allow five minutes for warm-up.

c. Indicator lamp (7) should glow. If lamp does not glow, check all fuses. Replace defective lamp or defective fuse.

d. Throw INPUT VOLTAGE ADJUST (2) to NORMAL.

e. Needle of INPUT VOLTAGE meter (1) should indicate 115 ± 10%. If reading is incorrect, reset INPUT VOLTAGE ADJUST.

3-10. SIGNAL GENERATOR SG-1A/ARN.

3-11. To adjust Signal Generator SG-1A/ARN, make sure the connections indicated in paragraph 3-6 have been made and all operations in paragraph 3-8 have been completed. Indicator lamp (7, figure 1-2) should glow. Proceed as follows:

a. Throw OSC SEL switch (19) to MO position.

b. Turn FREQUENCY knob (2) until dial reads 112.0 mc.

c. Adjust RF LEVEL (5) until needle of R. F. MONITOR meter (4) is on the red line.

d. Throw OSC SEL to OFF and adjust METER ZERO (11) until needle of PER CENT MODULATION meter (1) indicates zero.

e. Turn METER ZERO (20) until needle of R. F. MONITOR meter indicates zero.

f. Throw OSC SEL to MO.

g. Turn FREQUENCY knob until dial reads 88.0 mc.

h. Adjust RF LEVEL until needle of R. F. MONITOR meter is on the red line.

NOTE

There should be enough reserve on the RF LEVEL control to permit setting the needle of the R. F. MONITOR meter at least half-way between the red line and full scale.

i. Throw MOD switch (12) to 400 ~.

j. Throw MOD RANGE switch (9) to 100%.

k. Adjust MOD LEVEL control (10) until the needle of the PER CENT MODULATION meter indicates 100.

l. Throw MOD switch to EXT.

m. Throw OSC SEL to XTAL and XTAL FREQ (6) switch to 110.1 MC.

n. Turn FREQUENCY knob until dial reads 110.1.

o. Adjust RF LEVEL control unit needle of R. F. MONITOR meter is on the red line.

NOTE

There should be enough reserve on the RF LEVEL control to permit setting the needle of the R. F. MONITOR meter at least half-way between the red line and full scale.

p. Set XTAL FREQ switch to 114.9 MC and FREQUENCY dial to 114.9. Repeat steps n and o.

q. If the above procedures produce the indicated results, the equipment is ready for operation.

3-12. SEQUENCE OF OPERATION.

3-13. Connect the output, either modulated or unmodulated r-f, through Cable Assembly CG-409/U to the receiver under test. Because the various types of receivers to be tested may have different input im-

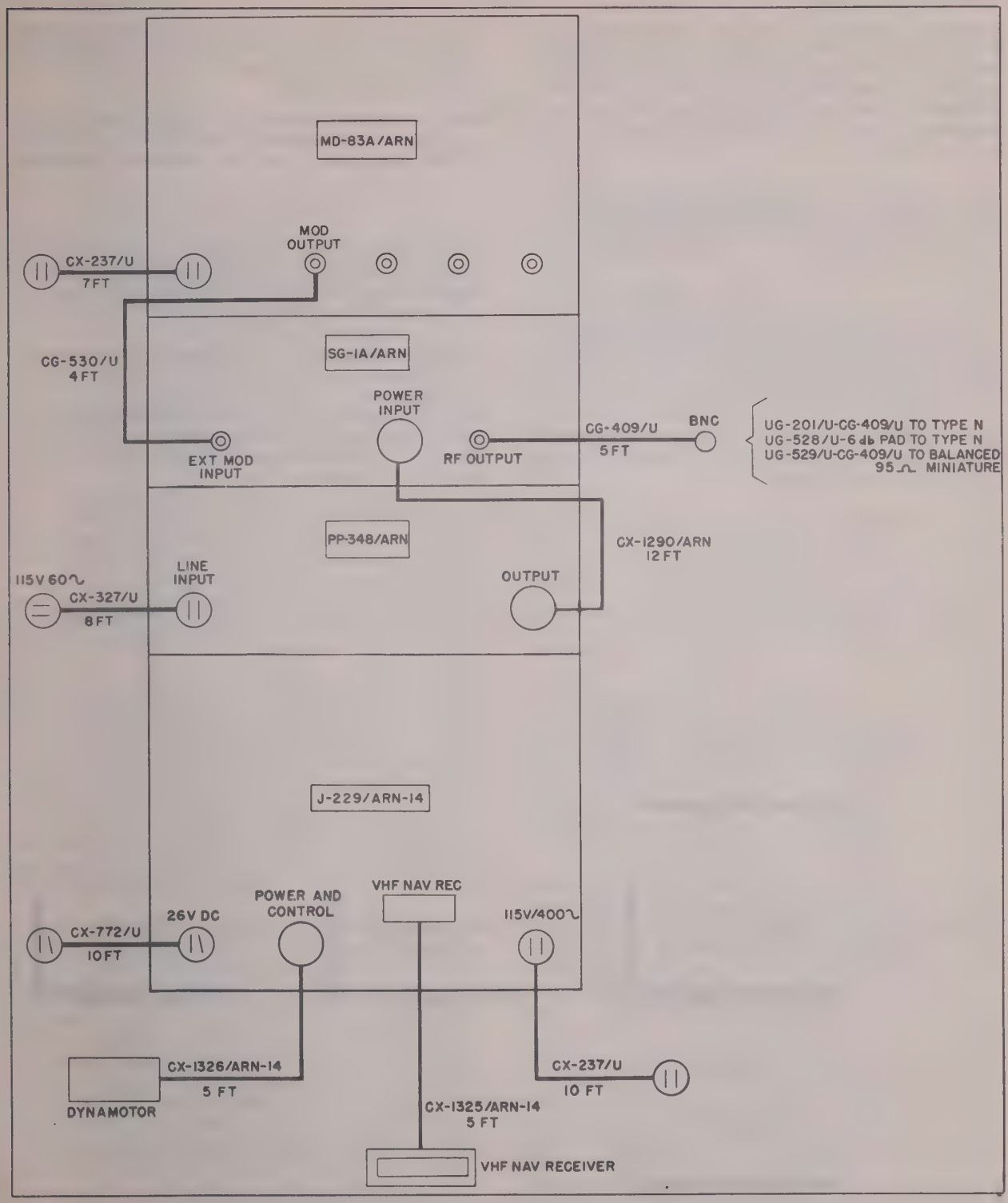


Figure 3-1. Signal Generator SG-1A/ARN, Cording Diagram

pedances, it may be necessary to connect the output of the signal generator through one of the adapters. The signals normally appear as deflections on indicators of the receiver under test. For more detailed information concerning the particular test and test procedures, refer to the applicable handbooks for each receiver.

3-14. In addition to the power supply, auxiliary equipment consists of Cable Assembly CG-409/U, Connector Adapter UG-201/U, Connector Adapter 528/U, and Connector Adapter 529/U.

3-15. Cable Assembly CG-409/U consists of a six-foot length of RG-58/U coaxial cable with UG-88/U connectors at each end. The cable is used between the signal generator RF OUTPUT connector and any one of the connector adapters.

3-16. Connector Adapter UG-201/U is used between Cable Assembly CG-409/U and a receiver with a Type N unbalanced 53-ohm input.

3-17. Connector Adapter UG-428/U provides a T-pad with six db. attenuation when connected between the signal generator and a receiver with a Type N unbalanced 53-ohm input.

3-18. Connector Adapter UG-529/U is used to connect R-F Cable Assembly CG-409/U to a balanced 95-ohm input with a twin-type miniature receptacle.

3-19. ADDITIONAL DATA.

3-20. Figure 3-1 is a diagram of the entire system showing the cords and the interconnections to be made to set up the equipment for system operation. Refer to the applicable handbook for each type of equipment for more detailed information.

3-21. REPACKING FOR STORAGE OR RESHIPMENT.

3-22. There are no special procedures for repacking the equipment. Carefully replace all components within the transit cases and pack the transit cases in any suitable shipping container.

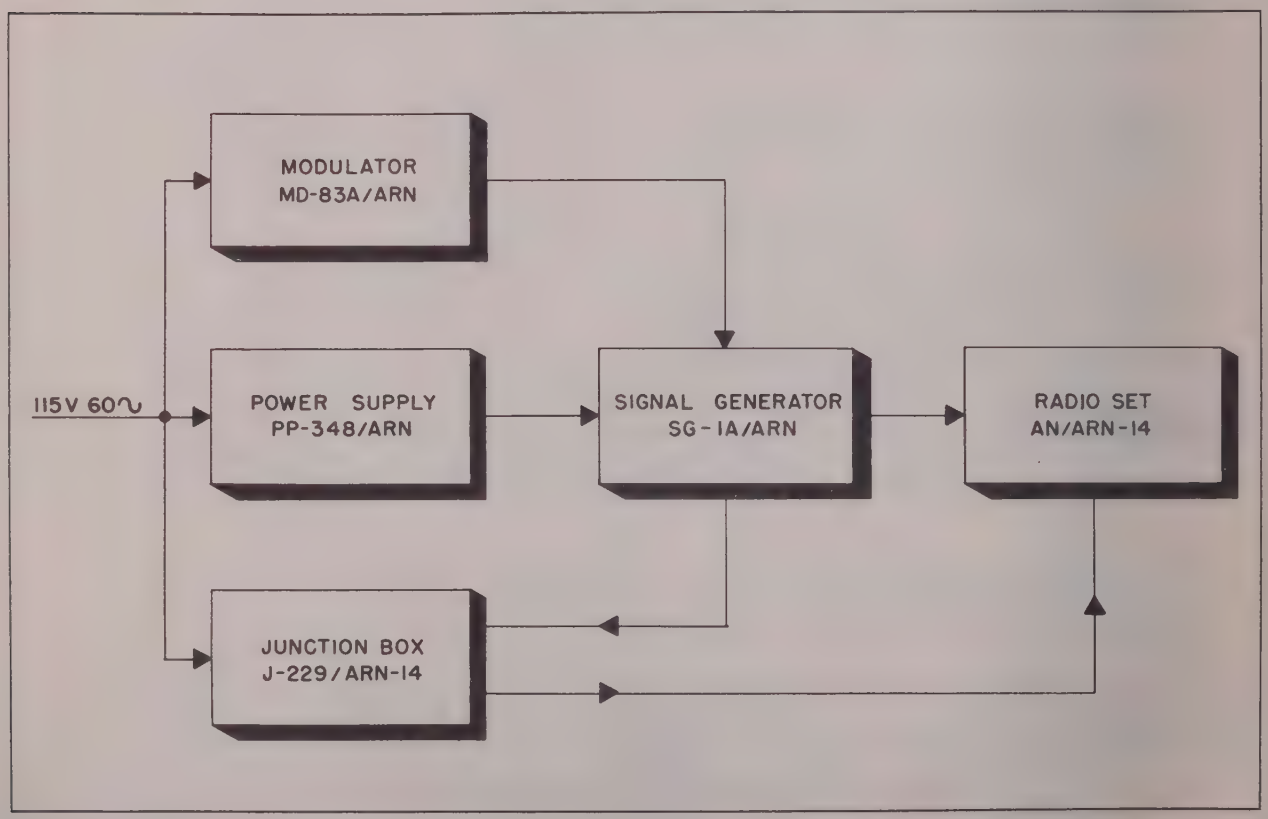


Figure 4-1. Signal Generator SG-1A/ARN, Block Diagram and Interconnecting Diagram

SECTION IV

THEORY OF OPERATION

4-1. GENERAL SYSTEM OPERATION.

4-2. The major components of the equipment are Signal Generator SG-1A/ARN and Power Supply PP-348/ARN (see figure 4-1). These units are employed to provide accurate r-f and a-f signals for use in testing v-h-f communications and navigation equipment. When used with auxiliary modulation equipment such as Junction Box J-229/ARN-14 and Modulator MD-83A/ARN, the output of the signal generator simulates signals from various aircraft h-f navigation stations such as omnidirectional range stations, tone or phase localizer systems, and v-h-f two-course ranges.

4-3. Signals generated by the equipment may be fed to v-h-f receivers, with various types of input networks and impedances, for alignment and test purposes. Modulation at either 400 cps to 1000 cps may be applied to the r-f output signal, or the r-f output may be modulated by a suitable external source. Interconnecting cables to match either balanced or unbalanced receiver inputs are supplied with the equipment.

4-4. R-f or modulated r-f signals from the signal generator are fed to the receiver, under test, from the RF OUTPUT connector through a coaxial cable which may include one of the adapters, to match the receiver input. Signals, which include navigation information, pass through the circuits of the receiver and appear as deflections on indicators which may be those used in an actual installation or those used with Junction Box J-229/ARN-14. Audible signals may be monitored at the junction box by connecting a pair of headphones to the AURAL jack.

4-5. Modulation intelligence generated by Modulator MD-83A/ARN-14 is fed to the signal generator as a modulating signal through the EXT MOD INPUT connector and Cable CG-530/U, supplied with MD-83A/ARN. The modulation is applied to the screen grid of the output stage through the audio and modulator stages and a filter network. The modulated signal is available at RF OUTPUT connector, and the percentage of modulation is indicated by the PER CENT MODULATION meter on the panel of SG-1A/ARN. The level of output signal is controlled by rotating OUTPUT LEVEL knob and is read on the dial associated with this knob.

4-6. When the signal generator is used without an external modulator, it is necessary to connect the output cable, through the applicable adapter, to the receiver under test. A modulated or unmodulated signal within the range of the signal generator is then available for alignment or test purposes. Refer to the applicable publication for each type of equipment to be tested.

4-7. FUNCTIONAL OPERATION OF COMPONENTS.

4-8. POWER SUPPLY.

4-9. BLOCK DIAGRAM.

4-10. Power Supply PP-348/ARN (see figure 4-2) delivers regulated voltages of +200v dc and +575v dc. The low voltage circuit provides a reference voltage for the high voltage circuits. The high voltage supply delivers plate power for the modulation amplifier and the modulator, and the low voltage supply delivers plate power for all other stages of the signal generator.

4-11. LOW VOLTAGE CIRCUIT. The rectified output of V802 is fed to series regulator tubes V807 and V808. Grid voltages for these tubes are controlled by the action of amplifier tube V809, which is controlled by the action of regulator tube V810 connected as the cathode load of V809. The output of the low voltage circuit is +200v d-c regulated, and this output is used as a reference voltage for the high voltage circuits.

4-12. HIGH VOLTAGE CIRCUIT. The high voltage circuit operates in a manner similar to the low voltage circuit. The output of rectifier V801 is fed to series regulator tubes V803 and V804. Grid voltages for these tubes are controlled by the action of amplifier tube V805. This tube is controlled by the action of voltage regulator tube V806, which is returned to the output of the low voltage supply circuit.

4-13. LOW VOLTAGE RECTIFIER (see figure 7-4). An input voltage of approximately 115v ac is applied from LINE INPUT plug J801 to the primary of transformer T802 through ACTIVE FUSES F803, F804, F801 and F802, contacts of POWER-ON-HEATER switch S802 and INPUT VOLTAGE ADJUST switch S801. The transformer steps up the voltage, and the stepped-up voltage across the secondary is rectified by full-wave rectifier tube V802 and filtered by coil L801B and capacitor C805. The filtered voltage is applied to the plates of series regulator tubes V807 and V808. The output voltage of these tubes is regulated by the action of regulator tube V810 and reference tube V809, and +200v d-c regulated is available across resistors R823, R824 and R825. The cathode of amplifier tube V809 is held at a constant reference potential of approximately 75v dc by the action of regulator tube V810, which is connected in series with resistor R822 across the +200v output terminals. The screen of amplifier tube V809 is maintained at the proper potential by means of a voltage divider consisting of resistors R819 and R820, and voltage divider consisting of resistors R819 and R821. Because the plate of tube V809 is connected to the grids

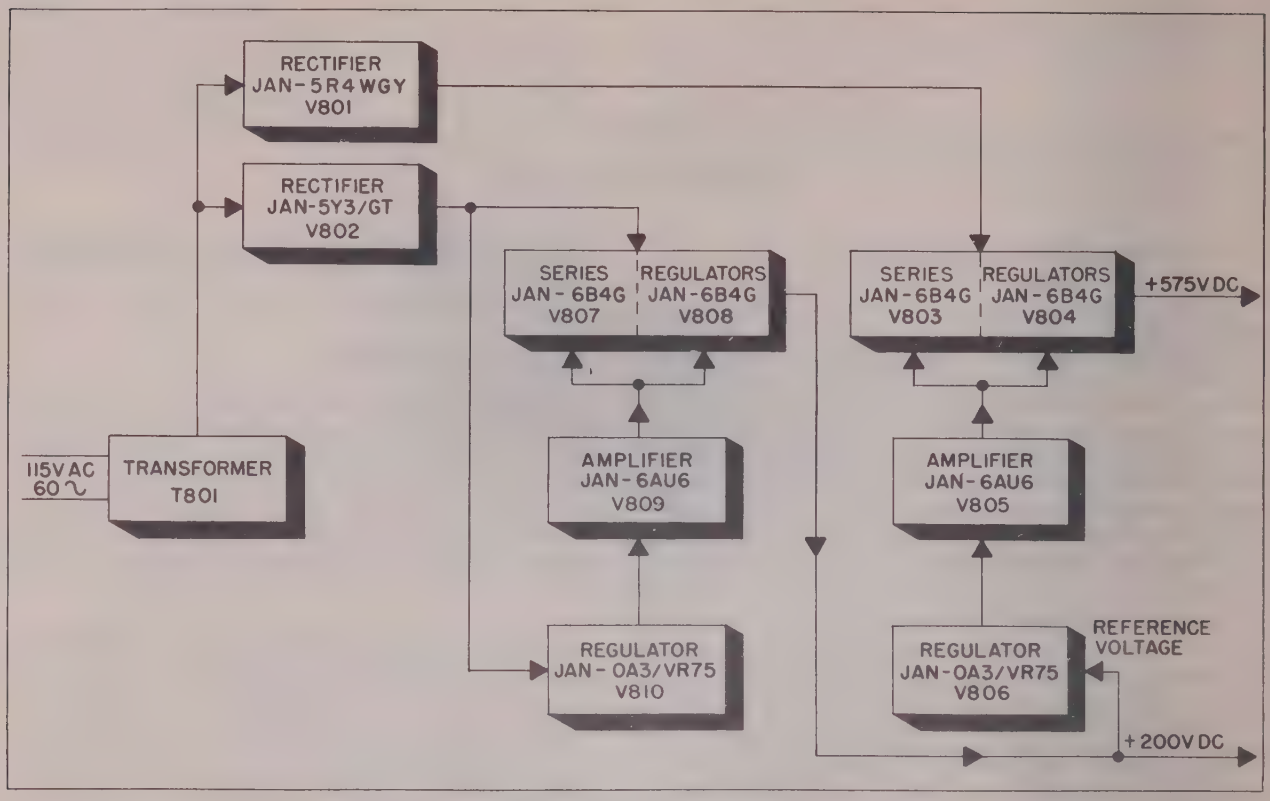


Figure 4-2. Power Supply PP-348/ARN, Block Diagram

of tubes V807 and V808 through resistors R817 and R818, any change in the plate current of tube V809, due to a change of screen potential, causes an amplified voltage change to be applied to the grids of tubes V807 and V808 which control the load current. The control grid of tube V809 is biased about five volts negative and provides regulating action proportional to the division of the voltage across resistors R823, R825 and potentiometer R824. Potentiometer R824 is used to adjust the regulated d-c output voltage of the supply to +200v by varying the operating point of tube V809. Capacitor C806 is a low impedance to low frequency transients and acts to bypass these around resistor R823 and a portion of potentiometer R824, thereby applying any output voltage variation to the grid of tube V809.

4-14. HIGH VOLTAGE RECTIFIER. The high voltage section is similar to the low voltage section except that the reference voltage used for regulation purposes is taken from the low voltage section instead of a voltage regulating tube, and a different voltage divider network is used to proportion the voltage variation applied to the screen grid of the amplifier tube V805.

4-15. To protect the modulator, the modulation amplifier, and the r-f output stages against possible damage from high voltage surges during the initial warm-up period, the contacts of time delay relay K801 remain open for about 40 seconds after POWER-ON-HEATER switch S802 is thrown to the ON position. When the relay closes, the 115v a-c line is connected to the primary of transformer T801 through the relay contacts, and the stepped-up voltage across the secondary of transformer T801 is applied to rectifier V801.

4-16. When the power supply is connected to an a-c power source through the LINE INPUT connector, and the POWER-ON-HEATER switch S801 is in the HEATER position, space heaters HR801 in the power supply and HR901 in the signal generator are connected across the power line.

4-17. To provide regulation of filament voltage for the tubes in the r-f unit, ballast resistor R826 is connected in series with one side of the heater line through jacks J802 and J902, thence to the r-f unit.

4-18. As an added precaution against accidental damage to the power supply and signal generator because of voltage surges, one side of the input line voltage circuit is closed through jumpers in the voltage regulator tubes. Disconnecting the interunit cable or removing either or both voltage regulator tubes will render the power supply inoperative.

4-19. INPUT VOLTAGE meter M801 is connected across the 115v a-c input circuit. The meter scale is calibrated from zero to 150 volts. INPUT VOLTAGE ADJUST switch S801 is used to select the particular primary tap that causes the voltmeter to read within the NORMAL space shown on the meter.

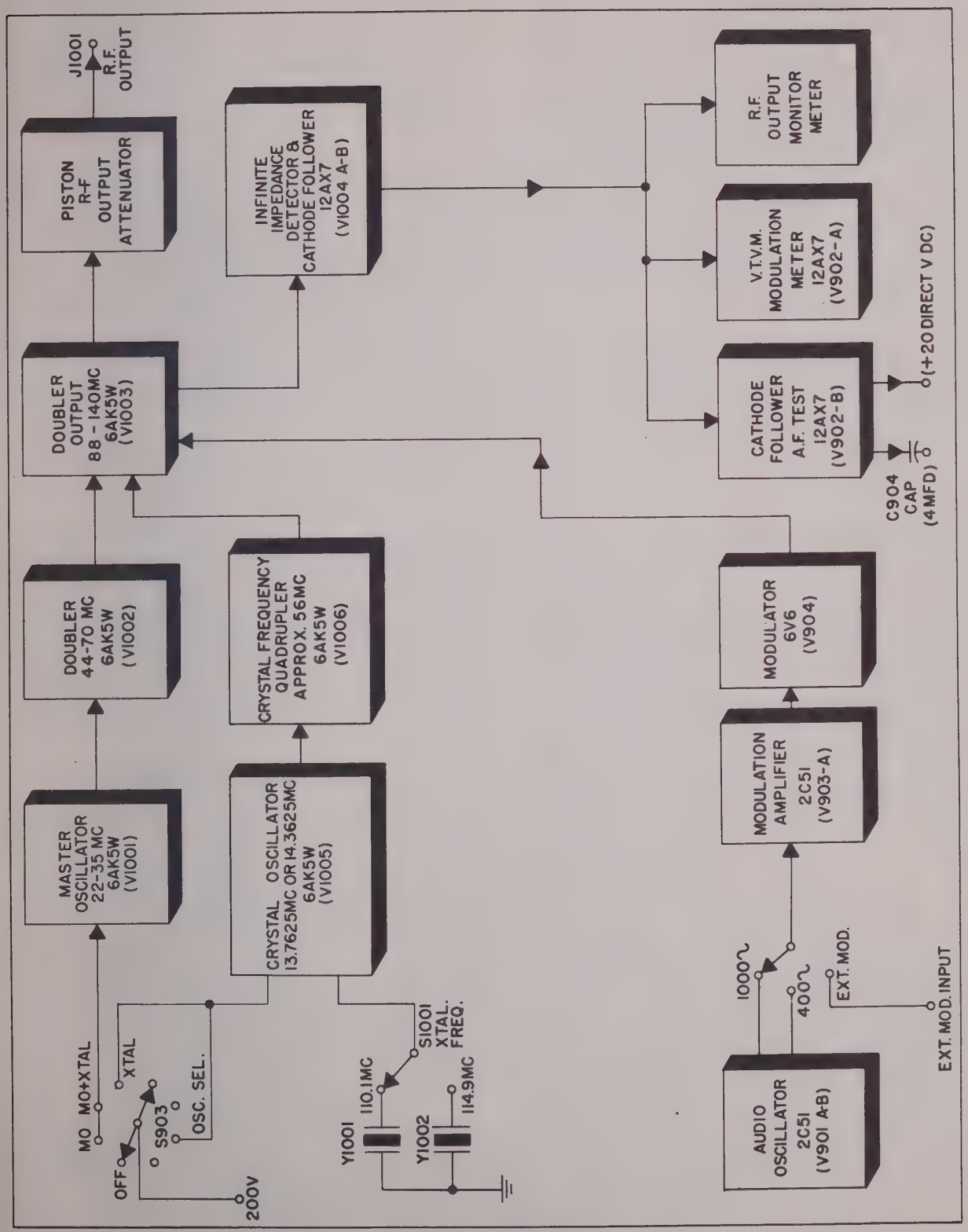


Figure 4-3. Signal Generator SG-1A/ARN, Block Diagram

4-20. SIGNAL GENERATOR.

4-21. BLOCK DIAGRAM. Figure 4-3 is a block diagram of the signal paths of the signal generator. Tube V1001 operates as a variable frequency oscillator developing a signal between 22 and 35 mc. The output signal of this stage is fed to tube V1002 operating as a doubler stage and the output signal of tube V1002 is fed to tube V1003 operating as a doubler. The output of this latter stage is a signal in the range of 88 to 140 mc. The r-f output of this stage is fed through a piston type r-f attenuator to RF OUTPUT jack J1001. The output of the crystal is fed to crystal oscillator tube V1005, thence to quadrupler tube V1006 and to doubler stage V1003. The output signal taken from OUTPUT jack J1001 is a fixed frequency of 110.1 mc or 114.9 mc, depending on the setting of XTAL FREQ switch S1001.

4-22. Audio signals of either 400 or 1000 cps originating in the circuits of oscillator tube V901, are fed to modulation amplifier tube V903, thence to modulator tube V904. A portion of the modulated signal is fed to infinite impedance detector tube V1004A, thence to cathode follower tube V1004B and to the modulation metering and test circuits.

4-23. R-F UNIT.

4-24. MASTER OSCILLATOR (see figure 7-3). Master oscillator tube V1001 operates as a Class C shunt-fed tuned plate oscillator operating in the range of 22 mc to 35 mc. R-f voltages developed across coil L1001 are coupled out through capacitor C1002 to the tuned tank consisting of coil L1002B in parallel with capacitors C1005A, C1004 and C1042. Voltages developed in the tank are coupled out by coil L1002A and fed to the grid of tube V1001 through capacitor C1003 to maintain oscillations. Resistor R1002 and capacitor C1003 form a grid biasing network for tube V1001. Screen and plate voltages for the tube are taken from pin M of POWER INPUT connector J902, and filtered by coils L1013 and L1014, and capacitors C1029, C1028 and C1027. Screen and plate voltages are decoupled by resistor R1001 and capacitor C1001.

4-25. DOUBLER (see figure 7-3). Signals developed in the shunt-fed tuned circuit (see paragraph 4-24) are coupled out by capacitor C1006 and fed to the grid of tube V1002 operating as a Class C doubler. The signals are amplified by the tube and fed through capacitor C1007 to the shunt-fed tuned tank circuit consisting of coil L1004 in parallel with capacitors C1005B and C1043. The tank doubles the frequency of the signals. Output signals from the tank are fed to tube V1003 as input signals. Resistor R1004 and capacitor C1006 form the grid bias network for the tubes. Screen and plate voltages for the tube are taken from the same connection points as the voltages for tube V1001. Screen voltage is decoupled by resistor R1003 and capacitor C1008. Plate voltage is dropped by resistor R1005. Resistor R1017 and coil L1003 are the plate load for the tube.

4-26. DOUBLER (see figure 7-3). Signals developed in the shunt-fed tuned circuit (see paragraph 4-25) are coupled out by capacitor C1010 and fed to the grid of tube V1003 operating as a Class C doubler. The signals are amplified by the tube and fed through capacitor C1013 to the shunt-fed tuned circuit consisting of coil L1006B in parallel with capacitors C1005C and C1044. The tank doubles the frequency

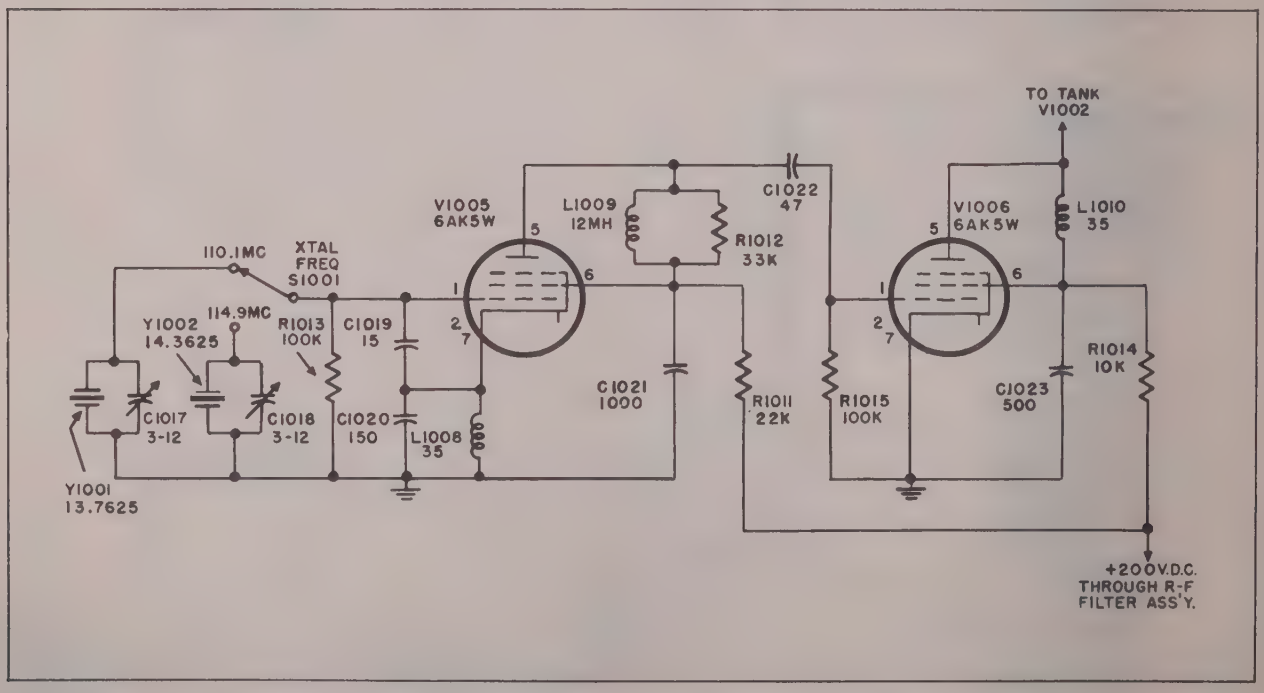


Figure 4-4. Crystal Oscillator and Quadruplet Stages, Schematic Diagram

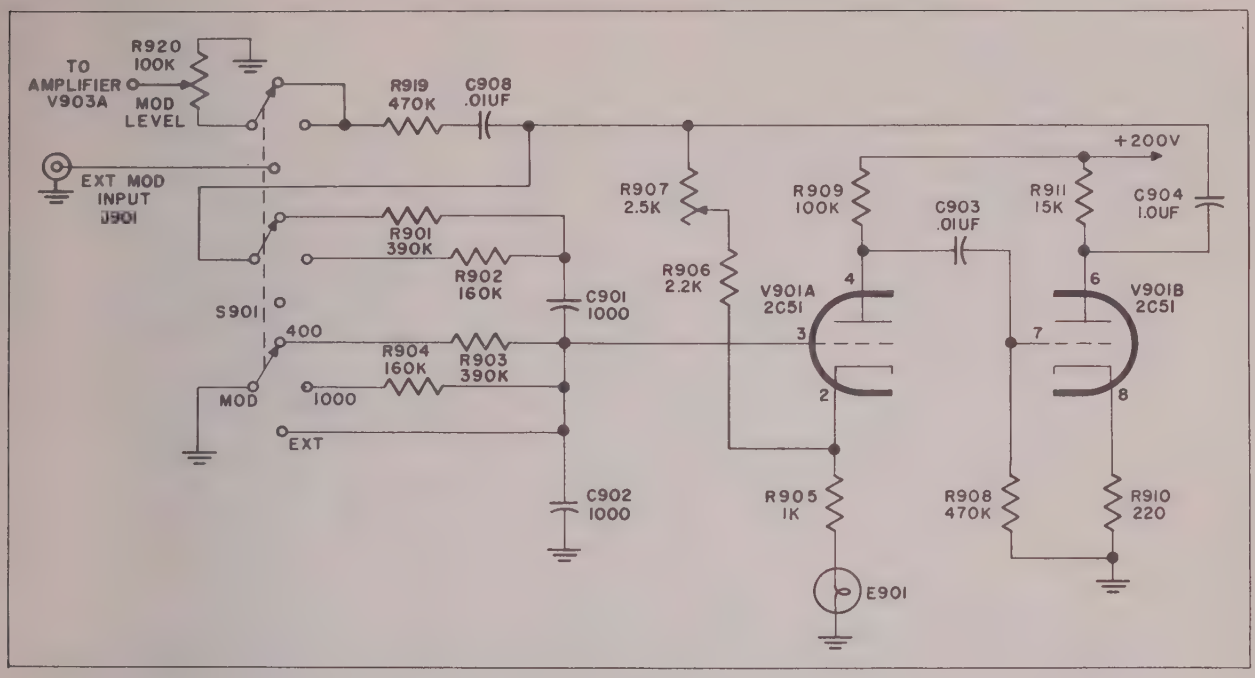


Figure 4-5. Audio Oscillator Stage, Schematic Diagram

of the signals. Output r-f signals of 88 mc to 140 mc are coupled from the tank by coil L1006A and fed through the piston attenuator and resistor R1008 to RF OUTPUT connector J1001. With a modulating signal applied to the screen of tube V1003, modulated r-f signals are available at RF OUTPUT connector J1001. Capacitor C1010 and resistor R1006 form the grid bias network for the tube. Voltage for the screen of the tube is taken from the top of the voltage divider consisting of potentiometer R934 and resistor R935, connected across the +200v supply and filtered by coils L1016, L1015, capacitors C1032, C1031 and C1030, and decoupled by resistor R1007 and capacitor C1012. Plate voltage is taken from pin M of connector J902 and filtered by coils L1022, L1021, capacitors C1041, C1040 and C1039. Coil L1005 and resistor R1016 form the plate load circuit, and capacitor C1011 is an r-f by-pass.

4-27. CRYSTAL OSCILLATOR (see figure 4-4). Oscillator tube V1005 operates as a crystal controlled oscillator developing fixed frequency signals of either 13.7625 mc or 14.3625 mc depending on the setting of XTAL FREQ switch S1001. Coil L1009 in conjunction with the tube capacitance and stray capacitances tunes the plate to approximately 14 mc. Plate and screen voltages for the tube are taken from the +200v supply and filtered by coils L1011, L1012 and capacitors C1024, C1025 and C1026, and decoupled by resistor R1011 and capacitor C1021. The output of the crystal oscillator is fed to tube V1006 as an input signal.

4-28. QUADRUPLER (see figure 4-4). Signals developed in the crystal oscillator are coupled out by capacitor C1022 and fed to the grid of tube V1006 operating as a Class C quadrupler. The signals are amplified by the tube and the frequency of the signal is quadrupled by the tank circuit consisting of coil L1010 and the tube capacitances. Output signals from the tank are coupled out by capacitor C1009 and fed to the tuned tank of tube V1002 (see paragraph 4-25). Plate and screen voltages for the tube are taken from the same junction as the voltages for tube V1005 (see paragraph 4-27), and decoupled by resistor R1014 and capacitor C1023. Capacitor C1022 and resistor R1015 form the grid bias network for the tube.

4-29. AUDIO CIRCUITS.

4-30. AUDIO OSCILLATOR (see figure 4-5). Audio voltages for modulating the r-f signals are developed in the Wien bridge oscillator circuit, tube V901 and the associated resistors and capacitors. Signals developed in tube V901A are coupled to tube V901B, amplified and fed back to tube V901A to maintain oscillations. The frequency determining networks connected in the grid circuit of tube V901A for generating either a 400 cps or a 1000 cps signal are selected by contacts of MOD switch S901. With switch S901 thrown to 400 ∼, resistors R901 and R903 and capacitors C901 and C902 are used to determine the frequency of oscillation. With switch S901 thrown to 1000 ∼, resistors R902 and R904 and capacitors C901 and C902 determine the frequency of oscillation. Potentiometer R907 is used to adjust the feedback level. Plate voltage for tubes V901A and V901B is taken from pin M of connector J902 and dropped by

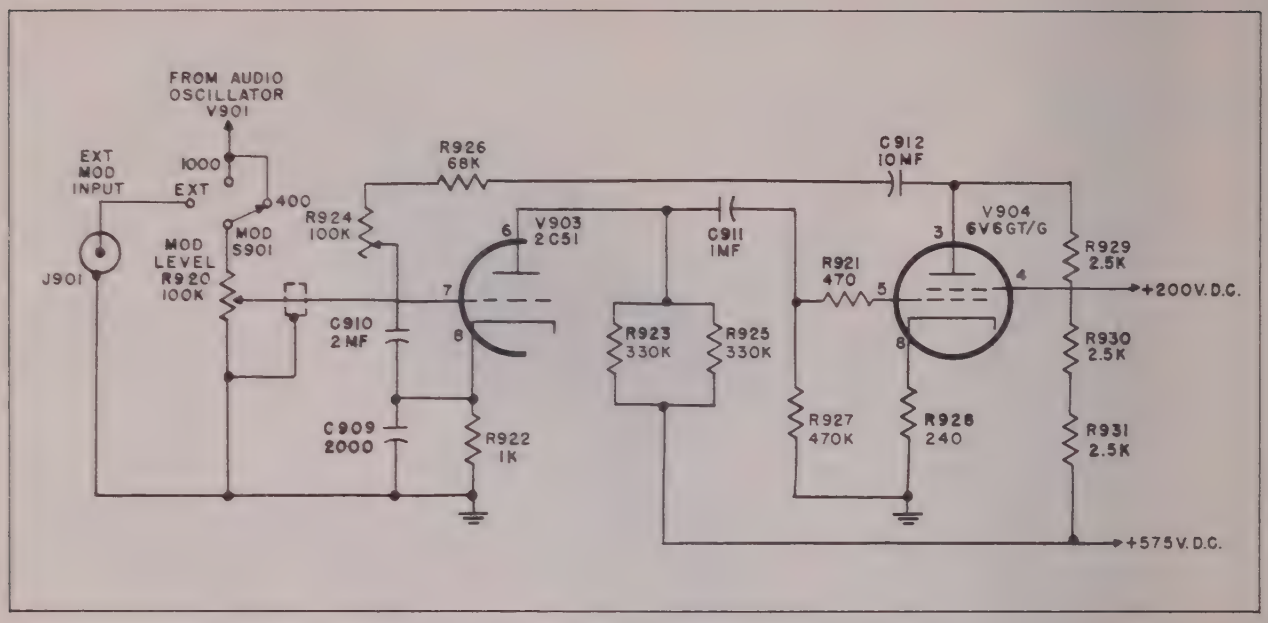


Figure 4-6. Modulation Amplifier, Schematic Diagram

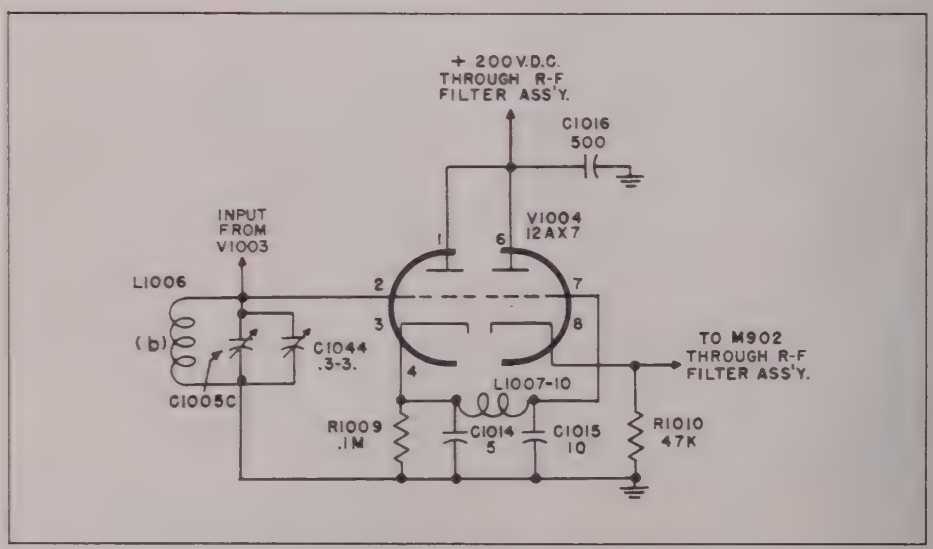


Figure 4-7. Demodulated Signal, Schematic Diagram

resistors R909 and R911. The signals developed in tube V901B are fed to modulating amplifier V903A through capacitor C908, resistor R919 and contacts of MOD switch S901.

4-31. MODULATING AMPLIFIERS (see figure 4-6). The input signal to the modulating amplifier tube V903A is taken from the output of V901B (paragraph 4-30) and is developed across the MOD LEVEL potentiometer R920 and then applied to the grid of tube V903A. The tube amplifies the signal which is then fed to tube V904 and amplified again. A portion of the output of tube V904 is fed back to tube V903A as a degenerative signal to correct for phase shift. The output of tube V904 is coupled out by capacitor C912 and fed through the modulating filter to the screen of tube V1003 as a modulating signal.

4-32. DEMODULATED SIGNALS (see figure 4-7). Modulated signals developed in the tuned tank con-

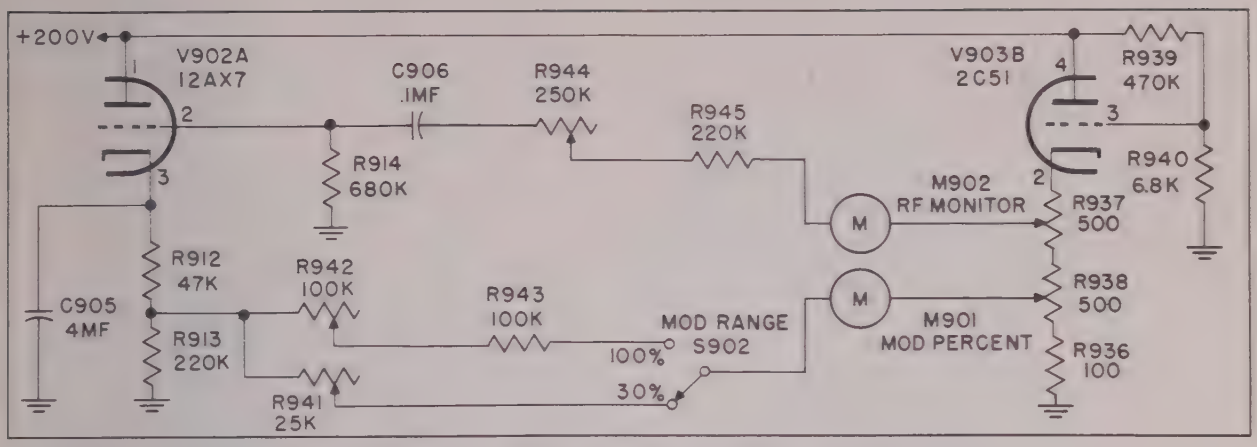
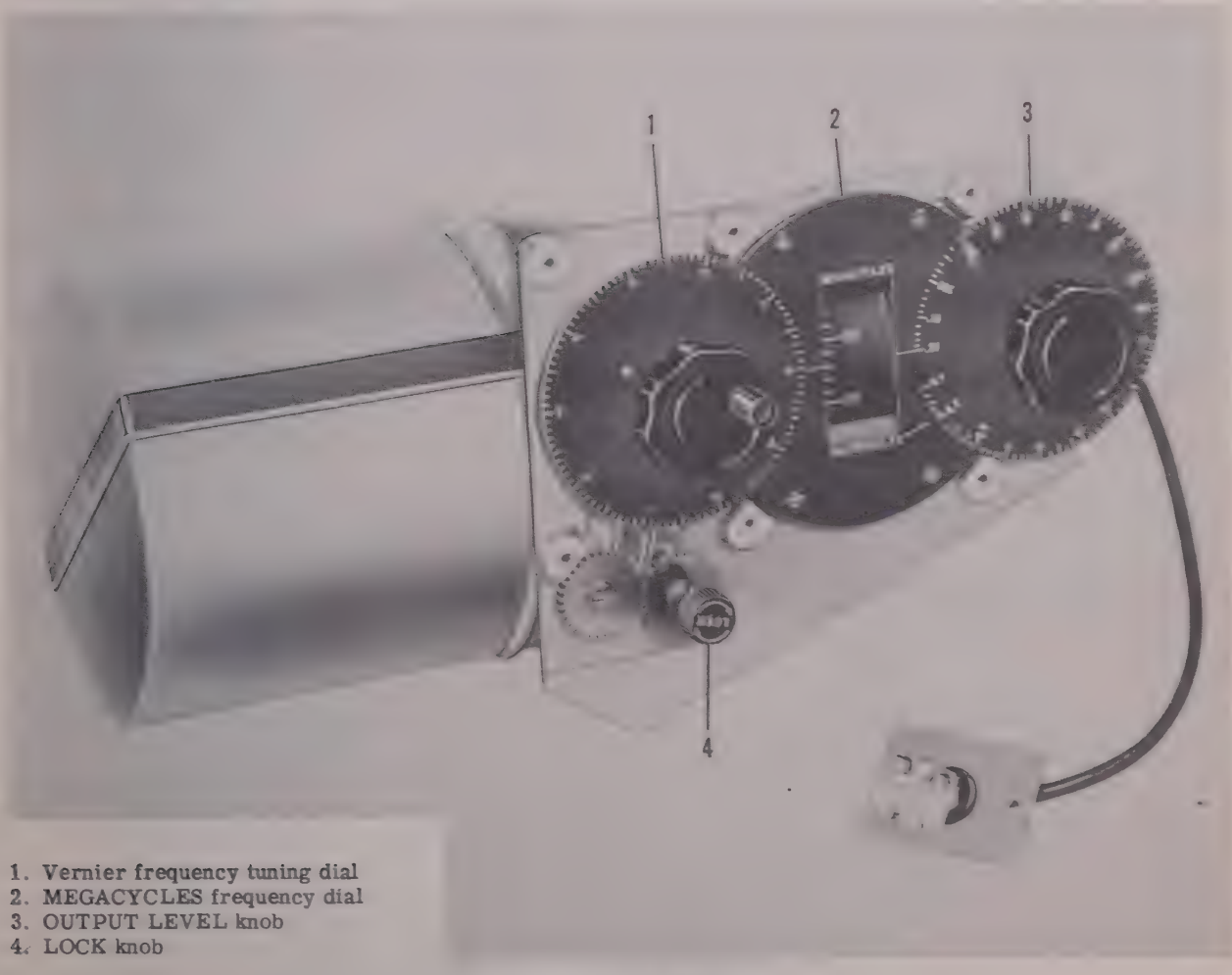


Figure 4-8. Meter Circuits, Schematic Diagram



1. Vernier frequency tuning dial
2. MEGACYCLES frequency dial
3. OUTPUT LEVEL knob
4. LOCK knob

Figure 4-9. R-F Unit

sisting of coil L1006 and capacitors C1005C and C1044 are applied to the grid of cathode coupled infinite impedance detector tube V1004A. The tube responds only to the modulated signal and the output at the cathode is essentially a d-c voltage that varies with the modulating envelope. The output of the detector is fed to tube V1004B connected as a cathode follower stage. The output signal of tube V1004B is developed across R1010 and fed through the filter network consisting of coils L1019, L1020, capacitors C1036, C1037 and C1038 to the input circuit of tube V902B. Tube V902B is connected as a cathode follower and the output circuit of the tube is tapped to provide a direct output connection or a connection through capacitor C907.

4-33. METER CIRCUITS (see figure 4-8).

4-34. PER CENT MODULATION METER. The a-c component of the demodulated output of tube V1004B (see paragraph 4-32) is coupled through capacitor C906 to VTVM tube V902A, and the d-c output of the tube is developed across cathode resistors R912 and R913. METER ZERO potentiometer R938 is used to zero the meter with no modulation applied to tube V1003. With modulation applied, and a signal at the grid of tube V902A, the potential at the junction of resistors R912 and R913 varies, a current flows through potentiometer R941 and the meter circuit and the meter indicates the percentage of modulation. The circuit for checking 100 per cent modulation is similar to that for checking 30 per cent modulation except that potentiometer R941 is replaced by potentiometer R942 and resistor R943 connected in series.

4-35. BALANCING CIRCUIT. Balancing tube V903B is used to maintain the zero setting of meters M901 and M902, caused by slight changes in the +200v d-c supply voltage. A rise in the +200v d-c supply develops a slight rise in grid bias voltage, causing the plate current in the tube to increase. The increased plate current causes an increase in cathode voltage which then reduces the grid bias voltage and reduces the plate current, restoring the voltage drop across the potentiometers. The tube operates in a similar manner for decreases in the +200v d-c supply.

4-36. FUNCTIONAL OPERATION OF MECHANICAL COMPONENTS.

4-37. SIGNAL GENERATOR.

4-38. The signal generator consists of the r-f unit, modulator circuits, audio frequency oscillator, and a panel and meter all supplied in one cabinet. The r-f unit (figure 4-9) is a self-contained section, housed in a round metal cover, containing the tubes and the electronic components. A vernier frequency tuning dial (1, figure 4-9) has 100 scale divisions and operates through a reduction gear of 120:1 ratio. This dial rotates the main tuning dial through the full frequency range of 52 vernier dial revolutions. The calibration of the main tuning capacitor assembly is such that one division of the vernier dial represents a change of 10 kc in output frequency.

4-39. The output piston attenuator is driven by a rack and pinion gear controlled from the front panel by the OUTPUT LEVEL knob (3). The dial associated with this knob is calibrated in microvolts.

4-40. The main MEGACYCLES frequency dial (2) is located in the center of the front panel and the vernier dial is to the left. For simplicity and ease of operation, both dials use the same marker. The frequency tuning dial is provided with a slipping clutch and locking device controlled by a LOCK knob (4) which is used for calibration purposes.

SECTION V

ORGANIZATION AND OPERATIONAL MAINTENANCE

5-1. PRELIMINARY INSPECTION.

5-2. Before performing any maintenance or repair to the units, personnel must carefully inspect the units for evidence of wear or deterioration of components. The following operations must be performed:

a. Clean the exterior of the units.
b. Check that the glass of the meters is not broken.
c. Check the contacts of all connectors.
d. Check all operating controls for positive action.
e. Check the pilot lamp and fuses.
f. Check the condition of all cables; look for frayed insulation and broken leads.

5-3. REMOVAL OF MAJOR UNITS.

WARNING

High voltages exist in the power supply and signal generator. Avoid bodily contact with exposed high voltage parts when removing either chassis from the cabinet. Before removing any unit, turn off primary power and disconnect all cables.

5-4. SIGNAL GENERATOR.

5-5. In order to test or inspect the signal generator, release the four spring latches at the sides, if the component is stacked with other equipment. If the unit is rack-mounted, loosen the screws which hold the unit in place on the rack.

5-6. To remove the chassis, loosen the ten screws on the front panel and remove the two screws along the top of the panel. Carefully slide the chassis slightly to one side to relieve the pressure on the screw threads. Remove the four screws on one side, then slide the chassis in the opposite direction and remove the four remaining screws. The chassis can now be removed easily from the cabinet. Place the chassis on a bench and remove the bottom plate containing the schematic diagram.

5-7. POWER SUPPLY. The power supply chassis is removed from the cabinet in the same manner as the signal generator. A schematic diagram of the power supply is on the inside of the bottom plate.

5-8. INSPECTION.

5-9. Carefully inspect the following items:

a. Check that the moisture-fungi-proof coating is not cracked.
b. Check each tube, one at a time, for evidence of cracked glass envelopes, broken bases, or broken pins.
c. Check that all tube shields are properly seated.
d. Check all resistors and capacitors for indications of overheating or other defects.
e. Check all transformers and coils for bulging and overheating.
f. Check all wiring.
g. Check that all screws are tight.
h. Check all grounding clamps.
i. Make sure that the r-f shield can is in place.

5-10. INSPECTION SCHEDULE.

5-11. The exterior items listed in paragraph 5-2 should be inspected daily. The interior items listed in paragraph 5-9 should be inspected weekly.

5-12. GENERAL SYSTEM TROUBLE SHOOTING. (See figure 1-2.)

5-13. The meters and controls of the units can be used as aids in localizing trouble. INPUT VOLTAGE meter M801 (1, figure 1-3) indicates that power is present and whether the voltage is low or high. R. F. MONITOR meter M902 (4, figure 1-2) indicates that r-f signals are present. The PER CENT MODULATION meter M901 (1) indicates that modulated signals are present. By setting OSC SEL switch S903 (19) to the MO or XTAL positions and observing R. F. MONITOR meter (4), it is possible to determine if these circuits are functioning. The XTAL FREQ selector switch (6) can be used to indicate failure of one of the crystal circuits. The MOD switch S901 (12) will aid in indicating failure of the audio tone circuits. The DEMOD OUTPUT terminals, DIRECT (+20 VDC) (14) and CAP (4 UF) (16) provide connections to vtvm circuits and provide convenient monitoring points.

5-14. By using various switch combinations while observing meters M901 and M902, it is possible to localize the faulty circuit. Then, by checking the voltage and resistance measurements (figures 7-1 and 7-2), the individual component in the circuit causing the trouble may be located.

5-15. Table VII lists general system troubles, the probable cause and suggested remedies.

5-16. POWER SUPPLY CHECK. (See figures 5-1 and 5-2.)

5-17. Troubles in the power supply will be indicated by one or more incorrect voltages at connector J902 of the signal generator. Such conditions may be indicated by lack of output signal or faulty operation of the signal generator. Because the high and low voltage supplies are interrelated, failure in the low voltage circuits may cause failure in the high voltage circuits.

TABLE VII. SYSTEM TROUBLE SHOOTING CHART

Step	Symptom	Probable Cause	Remedy
1.	No signals at test point 5. Meter M801 does not indicate correct voltage.	No input voltage at test points 1 and 2.	Check Cord CX-237/U.
		LINE fuses blown. ACTIVE fuses blown.	Replace defective fuses.
	Pilot lamps do not glow.	Defective pilot lamp.	Replace defective pilot lamps.
2.	Meter M801 reads correctly, but pilot lamp E902 does not glow.	Defective Cable Assembly CX-1290/ARN.	Check Cable.
3.	No signals at test point 5, but signals are present at test points A and B.	Defective r-f unit.	Replace r-f unit.
		Defective low voltage power supply - test points 3 and 7.	Check low voltage supply.
4.	No signals at test points A and B, but signals are present at test point 5.	Defective modulating signal.	Check modulation.
		Defective audio oscillator.	Check audio oscillator.
		Defective high voltage power supply - test points 4 and 6.	Check high voltage supply.

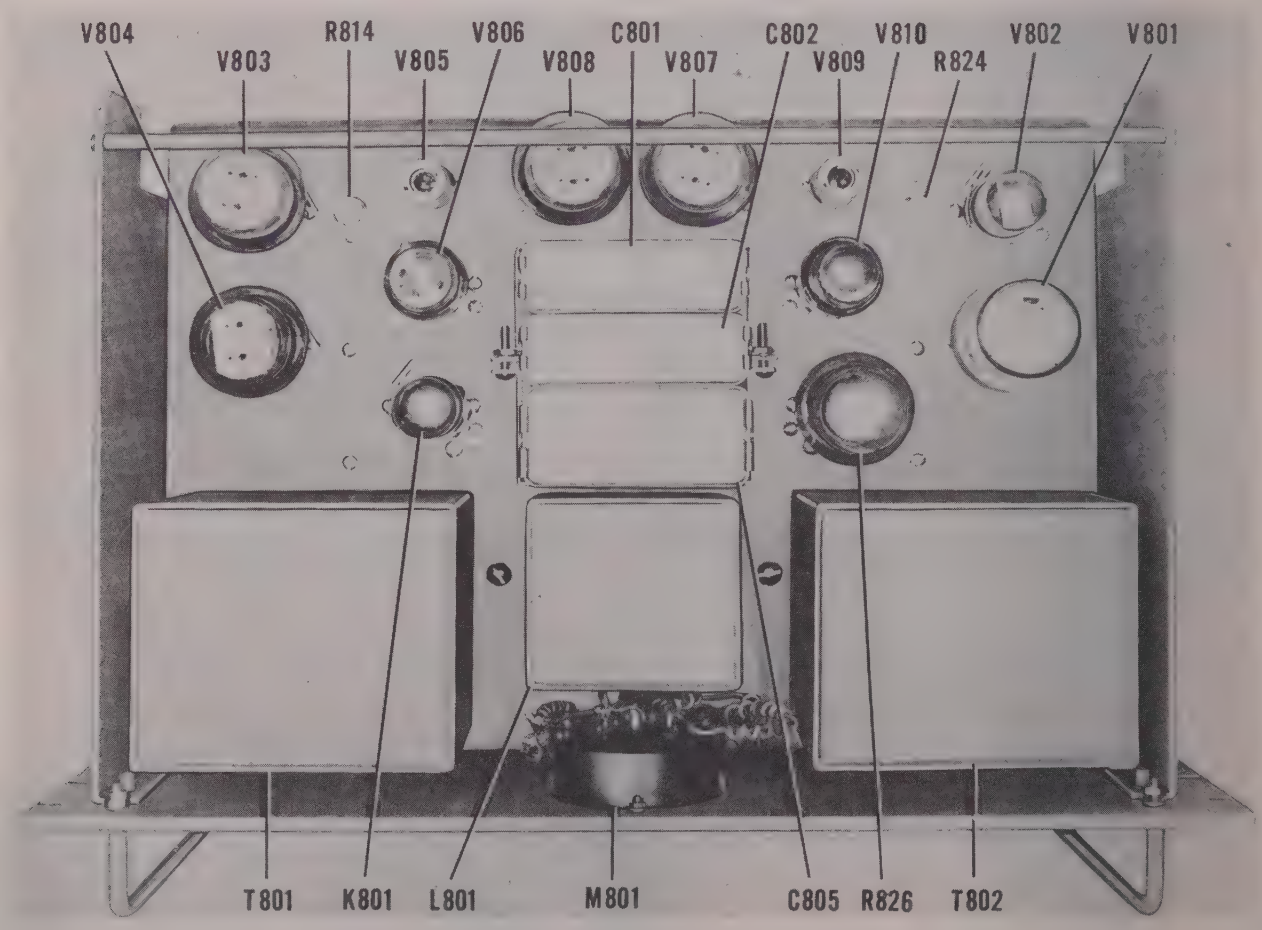


Figure 5-1. Power Supply PP-348/ARN, Top View

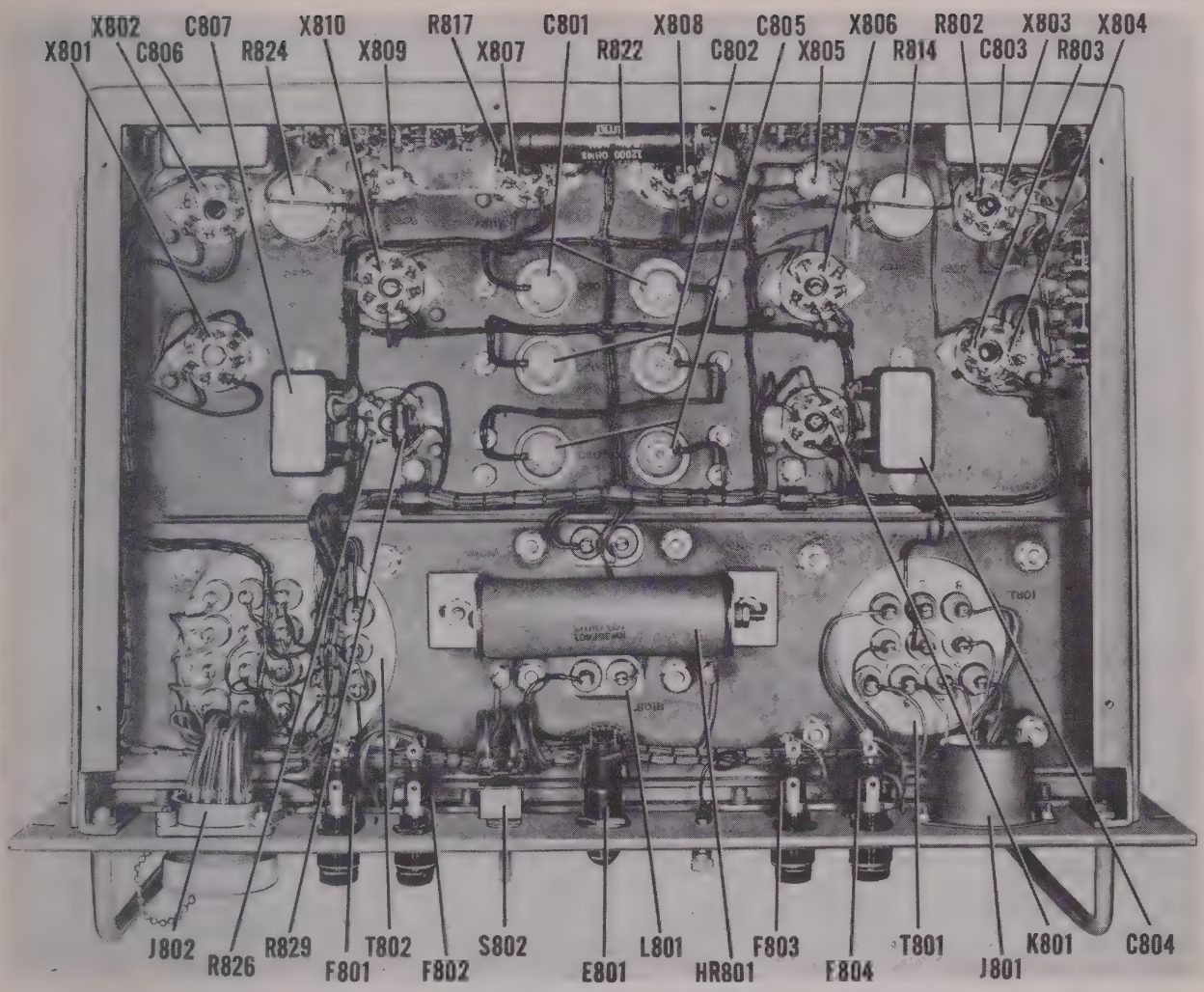


Figure 5-2. Power Supply PP-348/ARN, Bottom View

5-18. Before making any checks of the output voltage of the power supply, first check the input circuits. Connect the power supply to a suitable 115v a-c power source, throw POWER-ON-HEATER switch to the ON position and throw the INPUT VOLTAGE ADJUST switch to the NORMAL position. INPUT VOLTAGE meter should indicate 115v approximately. Throw switch to the ABOVE position, meter should indicate a voltage below 115v ac. Throw switch to the BELOW position, meter should indicate a voltage above 115v ac.

5-19. LOW VOLTAGE. To check the low voltage supply, proceed as follows:

a. Remove tube V801.

b. Connect a jumper across pins C and E of connector J802.

c. Connect a rheostat, 30,000 ohms, 25 watt, in series with a 0-100 milliammeter across pins M and G of connector J802.

d. Connect a VTVM across pins M and G. Set meter to read at least 200v dc.

e. Connect a VTVM across pins 1 and 7 of socket X809. Set meter to read 6v dc.

f. Adjust rheostat to maximum resistance.

g. Throw POWER-ON-HEATER switch S802 to ON. Allow five minutes for warm-up.

h. Adjust line voltage to 115v ac.

i. Adjust rheostat until milliammeter reads 90 ma.

j. Adjust potentiometer R824 until output voltage is +200v dc.

k. Vary load current (step i) from 90 ma to 10 ma, in steps of 5 ma. Meter across pins of socket X809 should read 3v ± 0.25v dc. Output voltage should read +200v ±4v dc.

l. Remove all jumpers and meters. Disconnect input power.

5-20. HIGH VOLTAGE. To check the high voltage supply, repeat steps in paragraph 5-11 and then proceed as follows:

a. Replace tube V801.

b. Connect a jumper across pins C and E of connector J802.

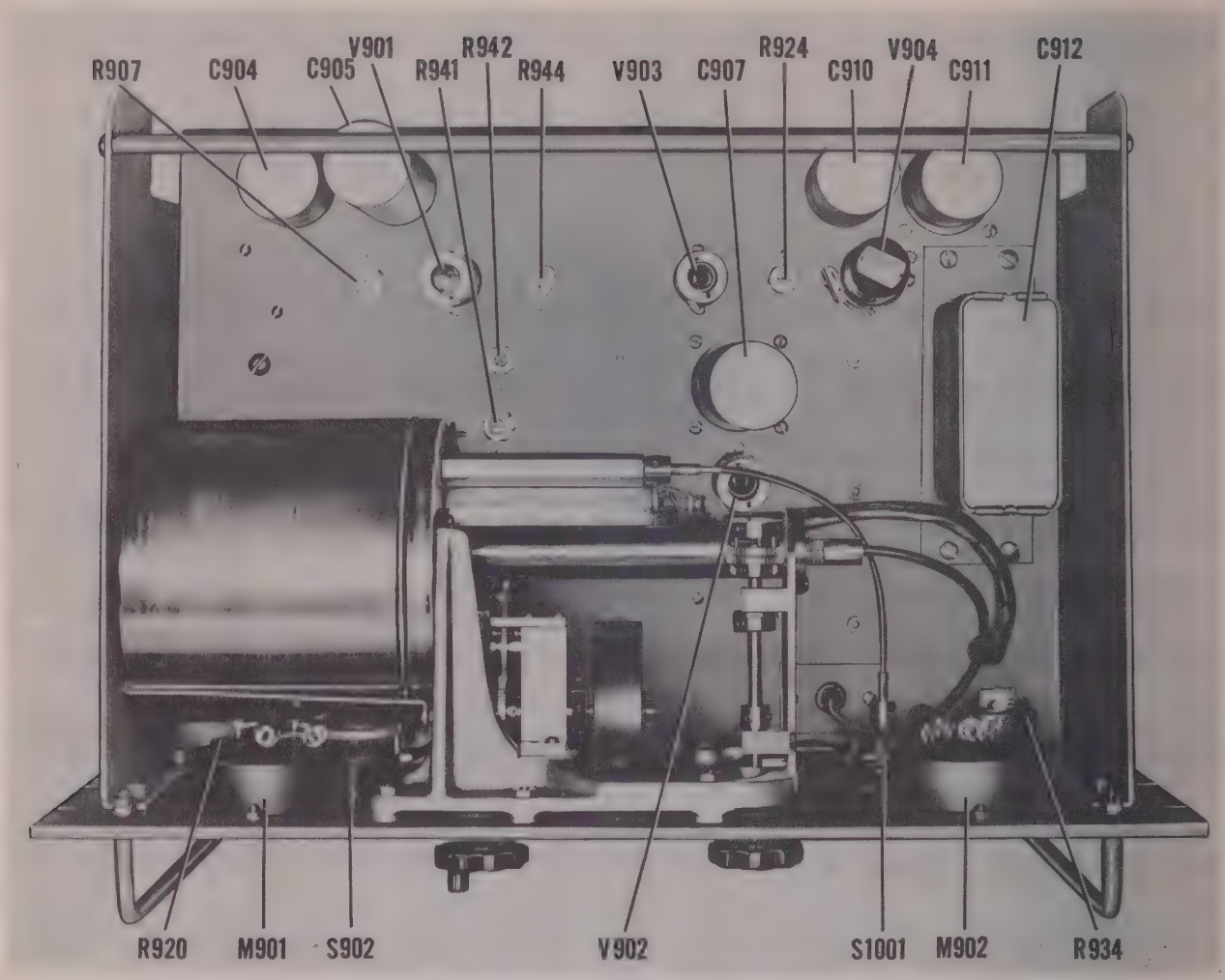


Figure 5-3. Signal Generator SG-1A/ARN, Top View

c. Connect a rheostat, 60,000 ohms, 25 watt, in series with a 0-100 milliammeter across pins H and G of connector J802.

d. Connect a VTVM across pins H and G. Set meter to read 600v dc.

e. Connect a VTVM across pins 1 and 7 of socket X805. Set meter to read 5v dc.

f. Adjust rheostat to maximum resistance.

g. Throw POWER-ON-HEATER switch S802 to ON. Allow five minutes for warm-up.

h. Adjust line voltage to 115v ac.

i. Adjust rheostat until milliammeter reads 90 ma.

j. Adjust R814 until output voltage is 575v dc.

k. Vary load current (step i) from 90 ma to 10 ma, in steps of 5 ma. Meter across pins of socket X805 should read 5v ± .2v dc. Output voltage should read 575v ±10v dc.

l. Remove all jumpers and meters. Disconnect input power.

5-21. SIGNAL GENERATOR CHECK.

5-22. GENERATOR AND MODULATOR. (See figures 5-3 and 5-4.)

5-23. To aid in locating trouble in the audio circuits, measure the resistance to ground at pins of connector J902. These measurements are to be made with the interunit cable disconnected. Resistance at pin M should be 8000 ohms; resistance at pins B and G should be zero; at all other pins the resistance should be infinity. Connect the equipment for normal operation with MOD switch S901 in 400 or 1000, and measure the voltage at pins of sockets X901, X902, X903 and X904. Refer to figure 7-1 for correct values. Measure the voltage from test point 8 to ground, the reading should be 14v ac.

5-24. R-F UNIT. (See figure 5-5.)

5-25. GENERAL. Other than replacing tubes, no repairs of the r-f unit are to be attempted. To determine whether the r-f unit is operative, personnel should check only the voltage and resistance measurements. When making these measurements, make sure that the placement of parts and wiring is not disturbed. The calibration of the unit will be affected by changing the placement of these components.

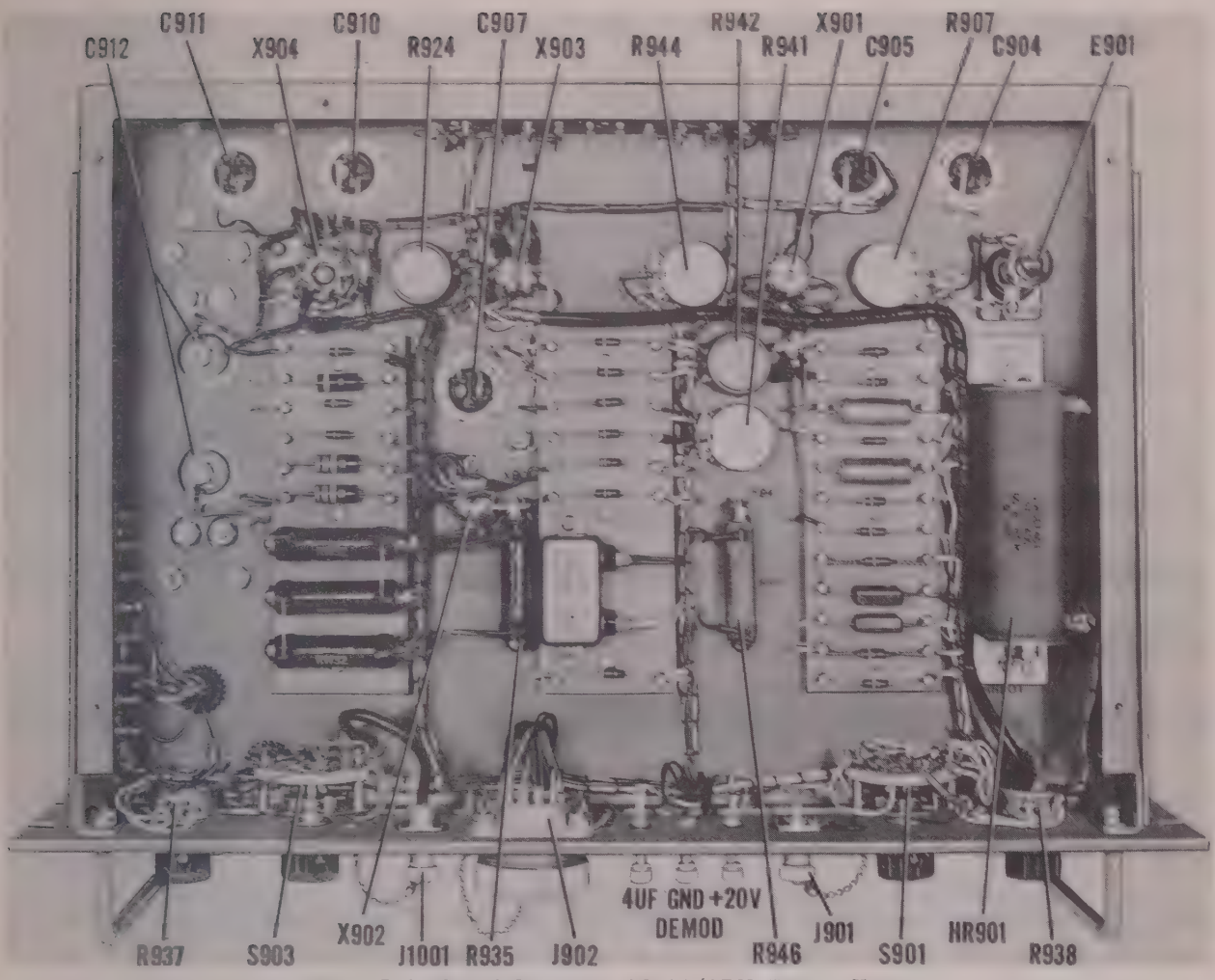


Figure 5-4. Signal Generator SG-1A/ARN, Bottom View

5-26. VOLTAGE AND RESISTANCE MEASUREMENTS. (See figure 7-1.) To measure the resistances, remove cover of r-f unit by releasing the two clamps. To check for correct voltages, connect the equipment for normal operation, and measure the voltage between test point 9 and ground. Normal reading is 6.1v ac ± 10 per cent. Check all voltages indicated in Table VIII. If readings are incorrect, a faulty tube or circuit is indicated. To replace a tube, remove primary power, remove cover of r-f unit by releasing the two clamps and check all resistance measurements. If resistances read normal, a tube is defective. Replace the tube. If resistances are incorrect, the r-f unit should be replaced, and sent to a suitable depot for overhaul.

5-27. METERS AND OUTPUT CIRCUITS.

5-28. To test these circuits, proceed as follows:

a. Connect the equipment for normal operation with MOD switch S901 thrown to EXT position.

b. Connect a d-c VTVM from DEMOD terminal (test point 14) of the terminal strip to the center arm of METER ZERO potentiometer R937.

c. Zero PER CENT MODULATION meter M901 by adjusting METER ZERO POTENTIOMETER R938.

d. Zero R. F. MONITOR meter M902 by adjusting METER ZERO potentiometer R937.

e. Throw switch S903 to MO position.

f. Adjust RF LEVEL potentiometer R934 until VTVM reads 26v dc.

g. Adjust potentiometer R944 until the needle of the R. F. MONITOR meter M902 is set exactly on the red line. Lock potentiometer R944.

h. Throw MOD switch S901 to the 400 ∼ position.

i. Connect an a-c VTVM across the d-c VTVM.

j. Adjust MOD LEVEL control R920 until a-c VTVM indicates 5.62v ac.

k. Throw MOD RANGE switch S902 to the 30% position.

l. Adjust potentiometer R941 until the needle of PER CENT MODULATION meter M901 indicates 30%.

m. Check the setting of R. F. MONITOR meter M902. If necessary to readjust the meter setting, adjust R F LEVEL control R934. Lock potentiometer R941.

n. Throw MOD RANGE switch S902 to the 100% position.

TABLE VIII - TYPICAL MEASUREMENTS AT TEST TERMINALS OF R F UNIT

Terminal Marking	Control Setting	Normal Reading
+200 Test Point 11	OSC SEL switch S903 in all four positions	200 v dc ± 4 v
XTAL Test Point 12	OSC SEL switch in XTAL or MO+XTAL OSC SEL switch in MO or OFF	200 v dc ± 4 v No reading
MO Test Point 10	OSC SEL switch in MO or MO+XTAL OSC SEL switch in XTAL or OFF.	200 v dc ± 4 v No reading
MOD Test Point 13	OSC SEL switch in OFF, potentiometer R920 rotated full counterclockwise, potentiometer R934 varied over full range OSC SEL switch in OFF, MOD switch to 400 ∼ or 1000 ∼, MOD LEVEL control as required	70 v to 170 v dc 100 v ac minimum
DEM Test Point 14	OSC SEL switch in OFF	If r-f unit is satisfactory, PER CENT MODULATION meter M901 and R.F. MONITOR meter M902 can be zeroed with potentiometers R938 and R937 with no radio frequency or modulation output

o. Adjust MOD LEVEL potentiometer R920 until a-c VTVM indicates 13.1v ac.
p. Reset the needle of R. F. MONITOR meter M902 to the line marker.
q. Adjust potentiometer R942 until meter M901 indicates 70%. Lock potentiometer R942.
r. Measure the voltages from DIRECT (+20 VDC) terminal to ground. Readings should be 6.3 to 6.6v ac and 16 to 17v dc.

5-29. REPAIR OF ELECTRONIC COMPONENTS.

5-30. R-F UNIT. The only component of this equipment which requires special attention is the r-f unit which should be replaced as a complete assembly when found defective.

5-31. REMOVAL OF R-F UNIT FROM SIGNAL GENERATOR.

5-32. When tests indicate that the r-f unit (1, figure 5-6) is defective and must be replaced, use the following procedure:
a. Loosen two setscrews (2) on the coupling at the end of the flexible shaft assembly (3) nearest the r-f unit. Pull the flexible drive shaft from the flexible shaft assembly.
b. Remove two screws (4) attaching the coaxial cable plate (5) to the chassis (6).
c. Remove four screws (7) and four lockwashers (8) holding the coaxial connector (9) to the front panel (10). Push the receptacle through the panel toward the rear and then pull it and the coaxial line up through the hole in the chassis (6).
d. Loosen setscrews (11) holding LOCK knob (12), FREQUENCY knob (13) and OUTPUT LEVEL knob (14) and remove the knobs.
e. Unsolder the eight wires on the test terminal strip (15). Pull these wires up through grommet (16).
f. Remove four screws (17), two screws (18), and six lockwashers (19) and six nuts (20) holding the r-f unit (1) to the front panel.
g. While holding the r-f unit with one hand, remove the screws (17) and (18) attaching r-f unit (1) to the front panel and carefully lift the unit off the panel.

5-33. REPLACING THE R-F UNIT.

5-34. When installing a new r-f unit, use the following procedure:
a. Hold the r-f unit (1, figure 5-6) in place on the panel, and fasten it with six screws (17 and 18), six nuts (20) and six lockwashers (19).
b. Feed the eight lead wires through the grommet (16), and solder to the test terminal strip (15). Be sure to match wire colors at the terminal pins.
c. Install the LOCK knob (12), FREQUENCY knob (13) and OUTPUT LEVEL knob (14) and tighten the setscrews (11).
d. Feed the r-f output coaxial cable through the chassis hole and carefully force coaxial connector (9) into position on the front panel (10). Install and tighten two screws (4) holding the coaxial cable plate (5) to the chassis (6), and four screws (7) attaching coaxial connector (9) to the front panel.
e. Throw the XTAL FREQ selector switch (6, figure 1-2) to 110.1 mc.

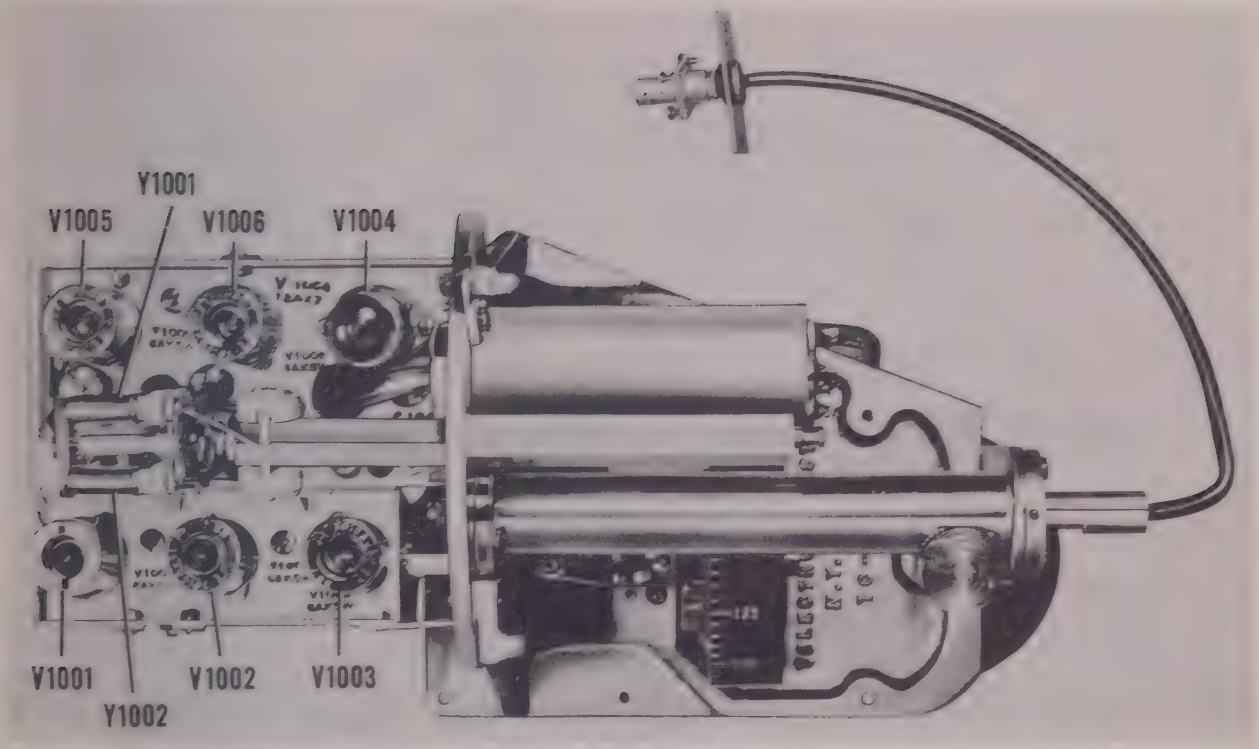


Figure 5-5. R-F Unit, Location of Tubes

f. Turn the flexible drive shaft fully counterclockwise before placing the coupling on the shaft. Push the coupling on and tighten setscrews (2).

g. Turn the power on and allow a five-minute warm-up period.

h. Turn OSC SEL switch (19, figure 1-2) to XTAL. Check operation of unit at both crystal frequencies. If the flexible shaft is properly installed, operation will be normal at both check points.

5-35. OPERATION TEST AFTER REPLACEMENT OF R-F UNIT.

5-36. After replacing an r-f unit, the equipment must be checked. Proceed as follows:

a. Throw the POWER switch (8, figure 1-3) to the ON position and allow equipment to warm up for five minutes.

b. Throw OSC SEL switch (19, figure 1-2) to MO position and set frequency dial to 112.0 mc.

c. Rotate RF LEVEL control (5) until needle of R. F. MONITOR meter (4) is at the red line.

d. Throw OSC SEL switch to OFF and zero PER CENT MODULATION meter (1) by rotating METER ZERO control (20).

e. Throw OSC SEL to MO position.

f. Adjust FREQUENCY dial (2) to 88.0 mc and adjust needle of R. F. MONITOR meter to red line by rotating the knob of RF LEVEL control.

g. There should be enough reserve on the RF LEVEL control to permit setting the needle of R. F. MONITOR meter at least half way between the red line and full scale reading.

h. Throw MOD switch (12) to 400 $\sim$ position.

i. Throw MOD RANGE switch (9) to 100% and rotate MOD LEVEL control (10) until needle of PER CENT MODULATION meter (1) indicates 100.

j. Throw OSC SEL switch to XTAL and XTAL FREQ selector switch (6) to 110.1 mc.

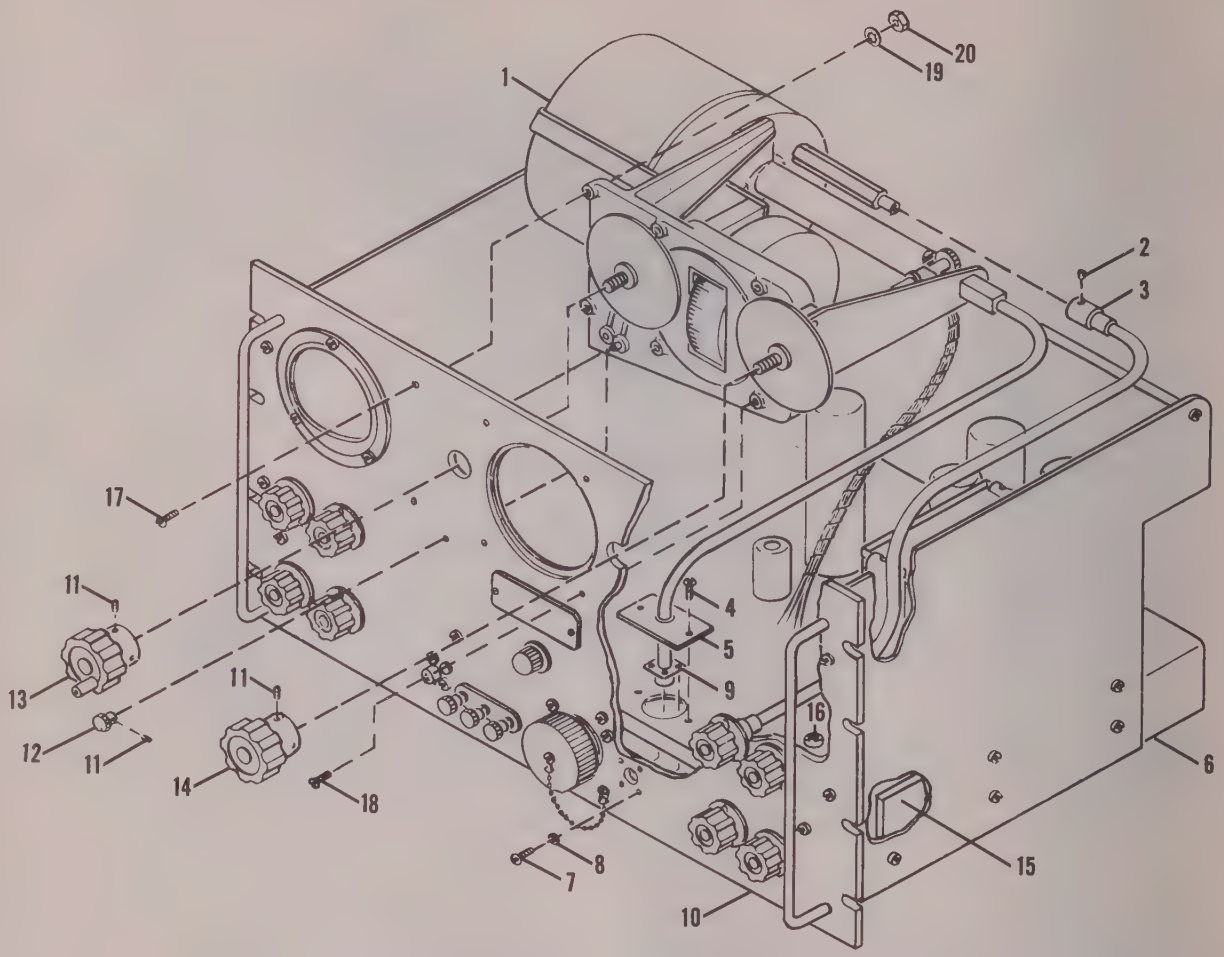
k. Set FREQUENCY dial to 110.1 mc.

l. It should be possible to set the needle of R. F. MONITOR meter at least half way between the red line and full scale by adjusting RF LEVEL control.

m. Repeat steps j through l for 114.9 mc settings of frequency dial and XTAL FREQ switch.

5-37. REASSEMBLY.

5-38. Reassembly procedures for both units are the reverse of the disassembly. Refer to paragraphs 5-3 to 5-7.



1. R-f Unit
2. Setscrew
3. Flexible Shaft
4. Screw
5. Plate
6. Chassis
7. Screw
8. Lockwasher
9. Connector
10. Front panel
11. Setscrew
12. LOCK knob
13. FREQUENCY knob
14. OUTPUT LEVEL knob
15. Terminal Strip
16. Grommet
17. Screw
18. Screw
19. Lockwasher
20. Nut

Figure 5-6. Removal of R-F Unit

SECTION VI

FIELD MAINTENANCE

6-1. GENERAL.

6-2. Before performing any maintenance, the equipment must be carefully inspected, internally and externally, for obvious defects; refer to paragraphs 5-1 to 5-11.

6-3. Usually a resistance and voltage check will locate defective components in the units. Check the readings as directed in paragraphs 6-4 to 6-7.

6-4. RESISTANCE MEASUREMENTS.

6-5. Resistance readings from all terminals to ground are indicated in figures 7-1 and 7-2. The notes which are a part of the figures indicate the condition of measurement and other pertinent data. To make these measurements the equipment must be disconnected from the source of power.

6-6. VOLTAGE MEASUREMENTS.

6-7. Voltage readings from all terminals to ground are indicated in figures 7-1 and 7-2. The notes which are a part of the figures indicate the conditions of measurement and other pertinent data. To make these measurements, the equipment must be connected for normal operation.

6-8. TROUBLE CHART.

6-9. Trouble charts to aid in locating and remedying trouble in the separate units are given in Tables IX and X. Connect the equipment for normal operation. Check the symptoms in the order listed to prevent unnecessary repetition of steps. Each step presupposes that the defects indicated in previous steps have been corrected.

TABLE IX. TROUBLE CHART - POWER SUPPLY PP-348/ARN

STEP	SYMPTOM	PROBABLE CAUSE	REMEDY
1.	No voltage at test points A and B	Defective source voltage Defective Cable CX-237/U Defective Connector J801 Defective fuses F803, F804 Defective switch S802 Defective fuses F802, F801 Defective relay K801 Defective transformer T801, T802	Check source Check Cable Replace defective components
2.	Incorrect voltage at test point A1	Defective tube V802 Defective coil L801 Defective capacitor C805	Replace defective components
3.	Incorrect voltage at test point A2	Defective tubes V807, V808, V809, V810 Defective resistors R816, R817, R818, R819, R820, R821	Replace defective components
4.	Incorrect voltage at test point A3	Defective resistor R822 Defective capacitor C807	Replace defective components
5.	Incorrect voltage at test point 3	Defective capacitor C806 Defective resistors R823, R825 Defective potentiometer R824	Replace defective components
6.	Incorrect voltage across test points C and D	Defective ballast R826 Defective resistor R829	Replace defective components
7.	No voltage at test points C and D	Defective tube V801	Replace defective components

TABLE IX. TROUBLE CHART - POWER SUPPLY PP-348/ARN (cont)

STEP	SYMPTOM	PROBABLE CAUSE	REMEDY
8.	Incorrect voltage at test point A4	Defective capacitors C801, C802 Defective coil L801	Replace defective components
9.	Incorrect voltage at test point A5	Defective tubes V803, V804, V805, V806 Defective resistors R801, R802, R803, R804, R805, R806, R807	Replace defective components
10.	Incorrect voltage at test point A6	Defective capacitor C804 Defective resistors R808, R809, R810, R811, R812	Replace defective components
11.	Incorrect voltage at test point 4	Defective capacitor C803 Defective resistors R813, R815 Defective potentiometer R814	Replace defective components

TABLE X. TROUBLE CHART - SIGNAL GENERATOR SG-1A/ARN

STEP	TROUBLE	PROBABLE CAUSE	REMEDY
1.	Incorrect voltage at test point 9	Defective Power Supply PP-348/ARN Defective Cable CX-1290/ARN Defective Connector J902 Defective pilot lamp E902 Defective resistor R946 Defective coils L1017, L1018 Defective capacitors C1033, C1034, C1035	Check power supply Replace defective components
2.	Incorrect voltage at test point 7 or 13 with switch S903 in OFF	Defective resistors R935, R939, R940 Defective potentiometer R934 Defective coils L1021, L1016, L1025, L1026 Defective capacitors C1039, C1040, C1041, C1030, C1031, C1032 Defective circuit tubes V1003, V1004	Replace defective components Replace tubes V1003, V1004 Check voltage and resistance measurements tubes V1003, V1004 Refer to steps 12 to 13
3.	Incorrect voltage at test point 10 with switch S903 in M.O.	Defective coils L1013, L1014 Defective capacitors C1027, C1028, C1029 Defective circuit tubes V1001, V1002	Replace defective components Replace tubes V1001, V1002 Check voltage and resistance measurements tubes V1001, V1002 Refer to steps 14 and 15
4.	Incorrect voltage at test point 12 with switch S903	Defective coils L1011, L1012 Defective capacitors C1024, C1025, C1026 Defective circuit tubes V1005, V1006	Replace defective tubes Check voltage and resistance measurements tubes V1005, V1006 Refer to steps 16 and 17
5.	Incorrect voltage at test point 8 with switch S901 in 400∿or 1000∿	Defective oscillator circuit	Replace defective tubes Check and replace all defective components
6.	R. F. MONITOR meter M902 does not zero when METER ZERO R938 is varied and switch S901 is in EXT position	Defective circuit tube V1004 Defective coils L1019, L1020 Defective capacitors C1036, C1037, C1038 Defective potentiometers R944, R937, R938 Defective meter M902 Defective resistor R945	Check and replace tube V1004 Replace defective components

TABLE X. TROUBLE CHART - SIGNAL GENERATOR SG-1A/ARN (cont)

STEP	TROUBLE	PROBABLE CAUSE	REMEDY
7.	Meter M902 does not indicate variations when R.F. LEVEL potentiometer M934 is rotated	Defective potentiometer R934 Defective resistor R933	Refer to step 6
8.	PER CENT MODULATION meter M901 does not zero when METER ZERO R938 is varied with switch S902 in 30% or 100% position	Defective meter M901 Defective potentiometer R941, R942 Defective circuit tube V902 Defective circuit tube V903, V904	Check and replace defective meter Replace defective components Check and replace defective tubes
9.	Needle of meter M901 does not indicate full scale when MOD LEVEL potentiometer R920 is varied	Defective potentiometer R920 Defective circuit tube V903 Defective circuit tube V904 Defective source voltage at test point 6	Check and replace tubes V903, V904 Replace defective components
10.	No output at test point A7	Defective tube V902 Defective resistors R915, R917, R918	Check and replace defective tube V902 Replace defective resistors
11.	No output at test point A8	Defective capacitor C907	Replace defective components
12.	Incorrect voltage at test point A9, after previous checks in step 2 have been made	Defective tube V1004 Defective capacitors C1016, C1014, C1015 Defective resistors R1009, R1010 Defective coil L1007 Defective tank circuit L1006, C1005C, C1004 Capacitor C1013 shorted	Check tube V1004 Replace defective components Replace tank circuit
13.	Incorrect voltage at test point A10, after previous checks in steps 2 and 12 have been made	Defective tube V1003 Defective coil L1005 Defective resistor R1016 Capacitors C1010, C1011, C1012 shorted Defective resistor R1006	Replace tube V1003 Replace defective components
14.	Incorrect voltage at test point A11, after previous checks in step 3 have been made	Defective tube V1002 Shorted capacitor C1006, C1007, C1008 Defective resistor R1003, R1004, R1005 Defective coil L1003 or resistor R1017 Defective tank L1004, C1005B, C1043	Replace tube V1002 Replace defective components
15.	Incorrect voltage at test point A12, after previous checks in steps 3 and 14 have been made	Defective tube V1001 Defective capacitor C1001, C1003 Defective resistor R1001, R1002 Defective coil L1001 Defective tank L1002, C1005A, C1042	Replace tube V1001 Replace defective components
16.	Incorrect voltage at test point A13, after previous checks in steps 4 and 14 have been made	Defective tube V1006 Defective resistor R1014, R1015 Defective coil L1008 Defective capacitors C1009, C1022, C1023	Replace tube V1006 Replace defective components

TABLE IX. TROUBLE CHART - POWER SUPPLY PP-348/ARN (cont)

STEP	SYMPTOM	PROBABLE CAUSE	REMEDY
17.	Incorrect voltage at test point A14, after previous checks in steps 4, 14 and 16 have been made	Defective tube V1005 Defective resistor R1011, R1013 Defective capacitor C1019, C1020, C1021 Defective coil L1008 Defective tank L1009, R1012	Replace tube V1005 Replace defective components
18.	No output signal at test point 5, after previous checks have been made with S903 in XTAL position	Defective crystal Y1001, Y1002 Defective capacitor C1017, C1018	Replace defective components

6-10. ALIGNMENT.

6-11. GENERAL.

6-12. The equipment must be aligned and tested after any major repairs have been performed. Alignment can be accomplished with the OSC SEL switch rotated to MO+XTAL position. With the switch in this position, harmonics of the master oscillator beat with the crystal oscillator to produce a beat note which is used to zero the variable oscillator with the crystal oscillator. The vernier FREQUENCY dial of the signal generator is provided with a friction clutch which permits rotation of the vernier dial shaft and the main MEGACYCLES frequency dial independently of the vernier dial. The dial lock knob holds the vernier dial stationary during adjustments. Because the demodulated r-f carrier appears at the DEMOD OUTPUT terminal on the front panel, it is possible to use headphones to locate the exact points at which the master oscillator and harmonics zero beat with the two crystal frequencies and the harmonics. Using this method, the vernier FREQUENCY dial can be set to the exact frequency at which a particular zero beat occurs.

6-13. CALIBRATION PROCEDURE.

6-14. To calibrate the signal generator, connect the equipment for normal operation, turn on power and allow at least a five-minute warm-up period. Throw MOD RANGE switch to 100% and the MOD switch to EXT. Throw XTAL FREQ switch to 110.1 mc and OSC SEL switch to MO + XTAL. Connect a set of high impedance headphones across the CAP (4 uf) and GND terminals. Proceed as follows:

a. Rotate FREQUENCY dial near 110.1 mc until a strong beat note is heard in the headphones. Tighten the LOCK knob.

b. Rotate the FREQUENCY knob against the friction of the clutch until the heterodyne beat is exactly zero.

c. The output frequency is now calibrated against the crystal oscillator and is accurate within +0.0035 per cent at this frequency.

6-15. Table XI lists check points at which the master oscillator may be checked against harmonics of the 110.1 mc crystal. Note that the relative output response of the various check points varies considerably.

6-16. Table XII is a list of check points at which the master oscillator may be checked against harmonics of the 114.9 mc crystal.

TABLE XI. CHECK POINTS FOR 110.1 MC CRYSTAL

Frequency (mc)	Relative Response Millivolts	Derivation of Beat Frequency*
88.080	37	8X-5M
89.456	12	13X-8M
91.750	60	5X-3M
93.585	3	17X-10M
94.371	3	12X-7M
96.337	230	7X-4M
99.090	8	9X-5M
100.925	45	11X-6M
102.236	2.5	13X-7M
103.219	7	15X-8M
103.983	6	17X-9M
104.595	33	19X-10M
105.512	25	23X-12M
106.168	27	27X-14M
106.659	20	31X-16M
107.042	7	35X-18M
110.100	2500	8X-4M
112.394	11	49X-24M
112.852	13	41X-20M
113.541	13	33X-16M
114.032	26	29X-14M
114.687	10	25X-12M
115.605	40	21X-10M
116.981	6	17X-8M
117.964	2	15X-7M
119.275	60	13X-6M
121.110	5	11X-5M
123.862	250	9X-4M
125.829	1.7	16X-7M
128.450	50	7X-3M
130.744	7	19X-8M

TABLE XI. CHECK POINTS FOR 110.1 MC CRYSTAL (cont)

Frequency (mc)	Relative Response Millivolts	Derivation of Beat Frequency*
132.120	40	12X-5M
133.0375	6	29X-12M
133.6929	23	17X-7M
135.7900	9	37X-15M
137.625	2000	5X-7M
139.090	11	9X-5M

* Numeral indicates order of harmonic:
X = Crystal Fundamental
M = Master Oscillator Fundamental

TABLE XII. CHECK POINTS FOR 114.9 MC CRYSTAL

Frequency (mc)	Relative Response Millivolts	Derivation of Beat Frequency*
88.794	17	17X-11M
89.367	8	14X-9M
90.279	20	11X-7M
91.920	20	8X-5M
93.356	5	13X-5M
95.750	50	5X-3M
97.665	4	17X-10M
98.486	4	12X-7M
100.537	300	7X-4M
102.133	1.5	16X-9M
103.410	15	9X-5M
105.325	50	11X-6M
106.693	5	13X-7M
107.719	10	15X-8M
108.525	5	17X-9M
109.155	30	19X-10M
110.112	20	23X-12M
110.796	25	27X-14M
111.309	14	31X-16M
111.708	5	35X-18M
114.900	2500	8X-4M
115.952	15	57X-28M
117.773	18	41X-20M
118.491	15	33X-16M
119.003	30	29X-14M
119.687	20	25X-12M
120.645	40	21X-10M
122.081	1.5	17X-8M
123.107	2.5	15X-7M
124.475	50	13X-6M
126.390	5	11X-5M
129.262	250	9X-4M
131.315	2.5	16X-7M

TABLE XII. CHECK POINTS FOR 114.9 MC CRYSTAL (cont)

Frequency (mc)	Relative Response Millivolts	Derivation of Beat Frequency*
134.050	30	7X-3M
137.880	40	12X-5M
139.533	20	17X-7M

* Numeral indicates order of harmonic.
X = Crystal Fundamental
M = Master Oscillator Fundamental

6-17. FREQUENCY CALIBRATION CHECK.

6-18. To check the frequency calibration of the equipment, it is necessary to beat the output of the signal generator against a standard 100 kc and 1 mc crystal oscillator. Connect the output of the generator at J1001 and the output of the standard crystal oscillator to the input of a suitable r-f detector and proceed as follows:

a. Set the frequency dial to 140 mc.

b. Check the frequency at each 2 mc division. If the beat note is not heard within ±20 kc of the setting, adjust the serrated plates of variable capacitors C1005A, B and C.

c. Repeat step b at each 1 mc division.

d. Overall accuracies should be as indicated in Table XIII.

TABLE XIII. FREQUENCY CALIBRATION ACCURACY

Frequency (mc)	Tolerance (kc)
88- 90	± 50
91- 95	± 30
96-130	± 20
130-138	± 30
138-140	± 50

6-19. AUDIO DISTORTION CHECK.

6-20. To check for distortion of audio voltages, connect a distortion meter across the extreme terminals of MOD LEVEL potentiometer R920 and proceed as follows:

a. Throw MOD switch S901 to 400∼ position. Distortion should be less than 0.5%.

b. Repeat with MOD switch S901 in 1000∼ position.

c. Connect distortion meter from DEMOD terminal to GND terminal.

d. Adjust frequency to 112 mc and set the needle of R. F. MONITOR meter M902 to the red line.

e. Adjust the level of modulation to 90%.

f. Distortion reading should be less than 5%.

SECTION VII

DIAGRAMS

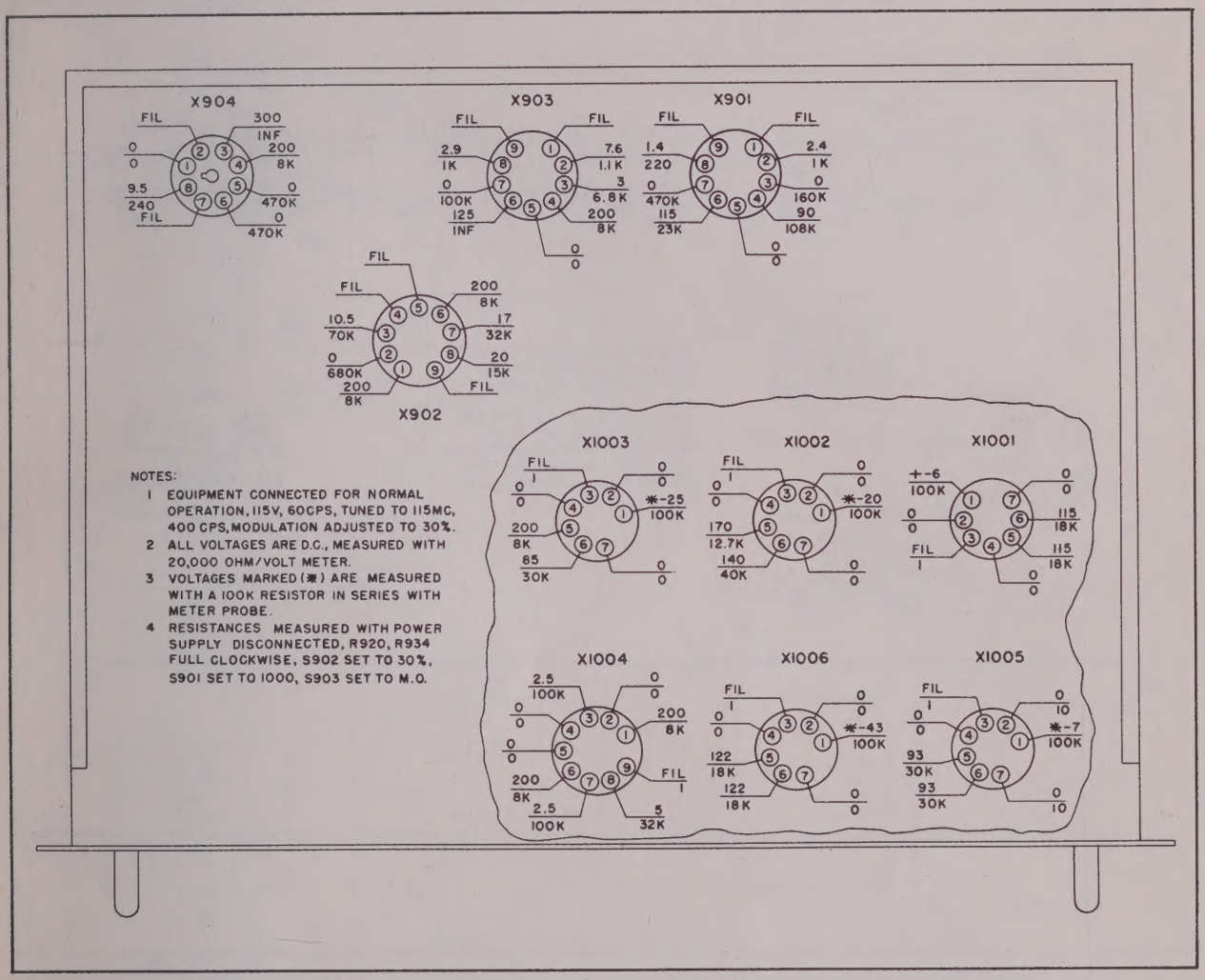


Figure 7-1. Signal Generator SG-1A/ARN, Voltage and Resistance Measurements

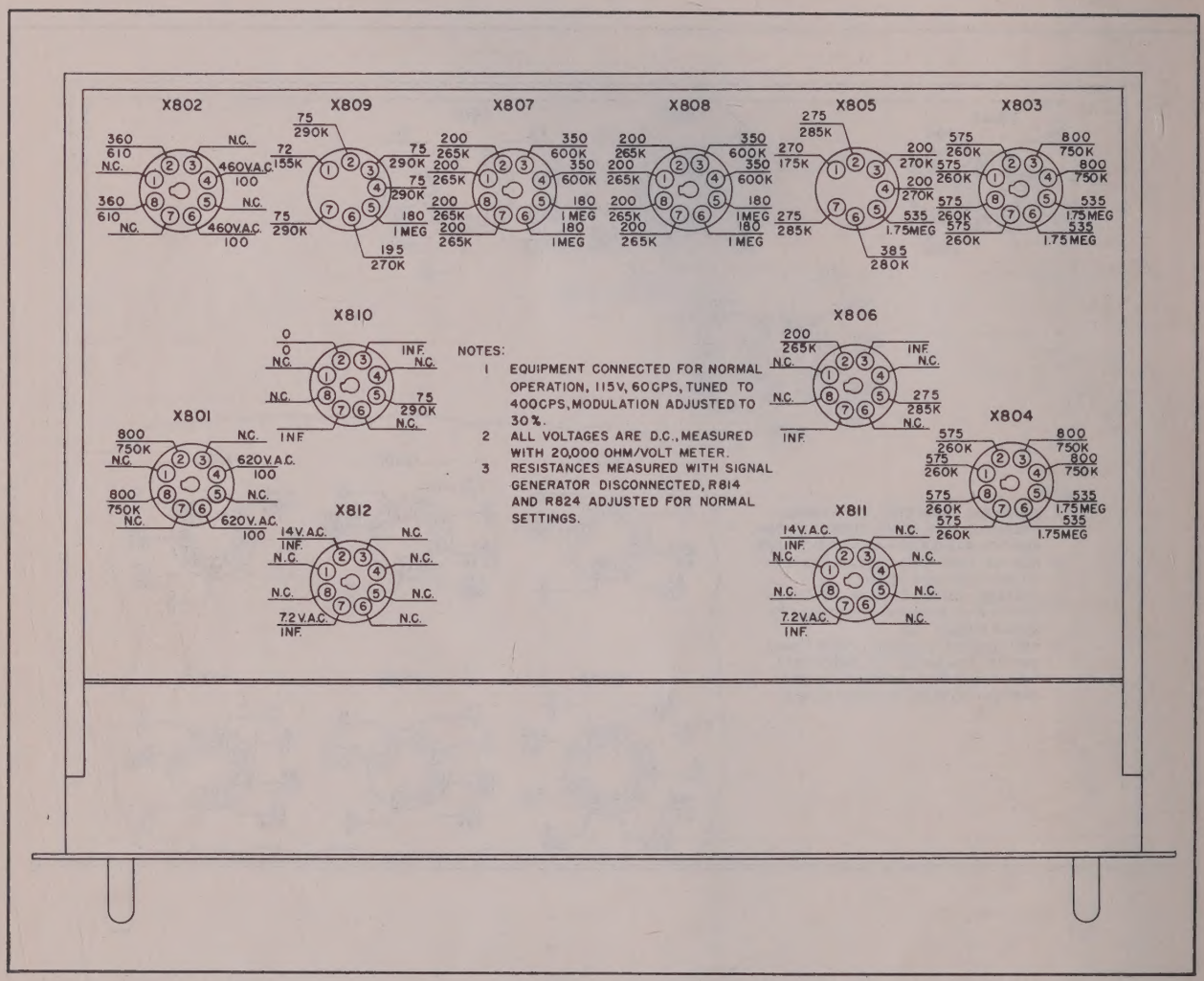


Figure 7-2. Power Supply PP-348/ARN, Voltage and Resistance Measurements

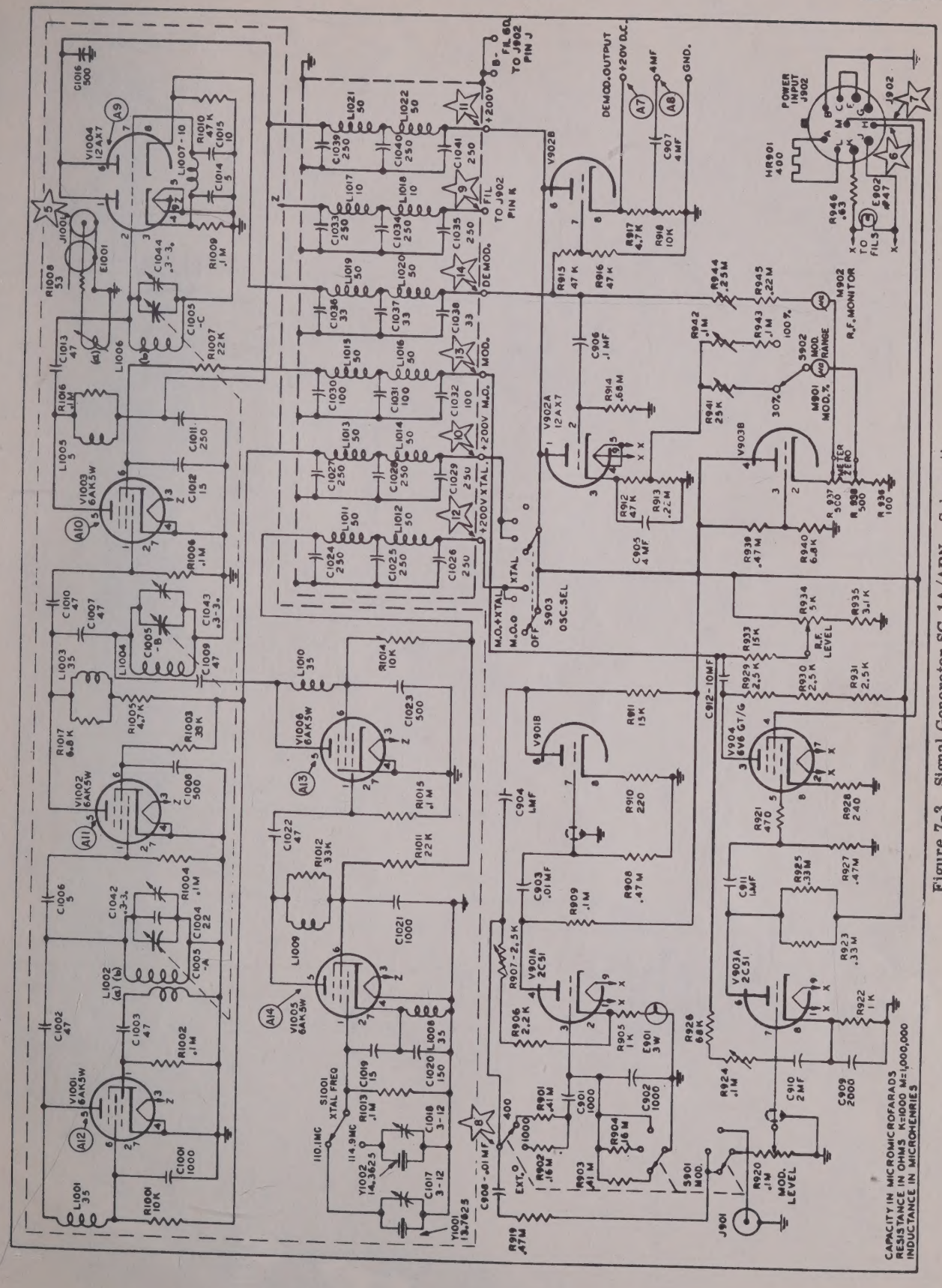


Figure 7-3. Signal Generator SG-1A/ARN, Schematic

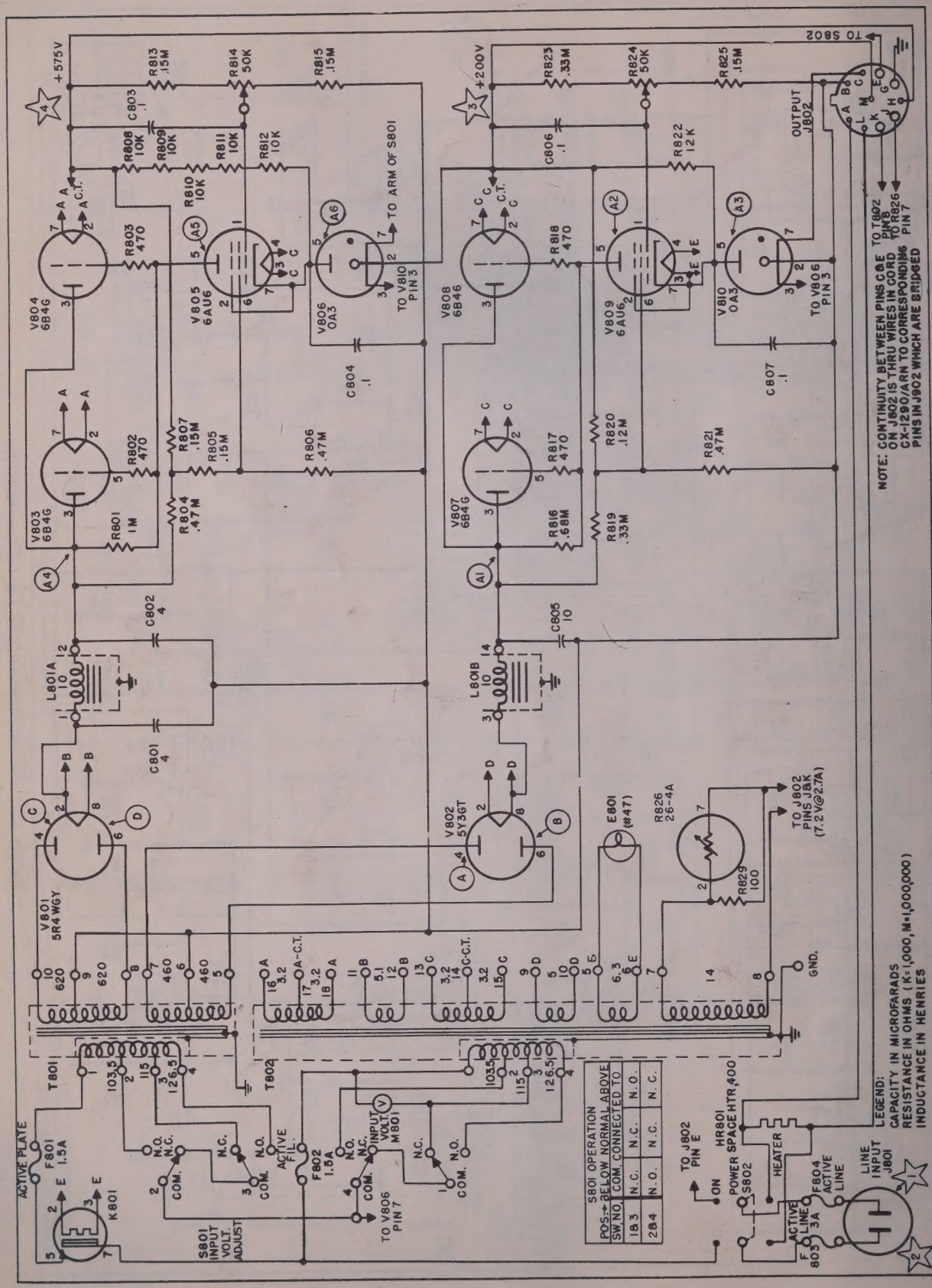


Figure 7-4. Power Supply PP-348/ARN, Schematic